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The PRACTICAL ENGINEER

Vol. VI. Philadelphia, April, 1902. No. 3.

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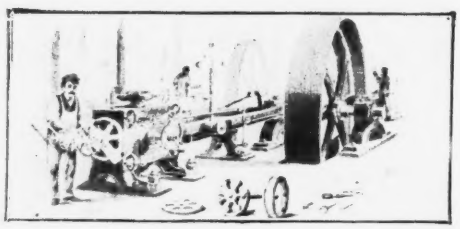

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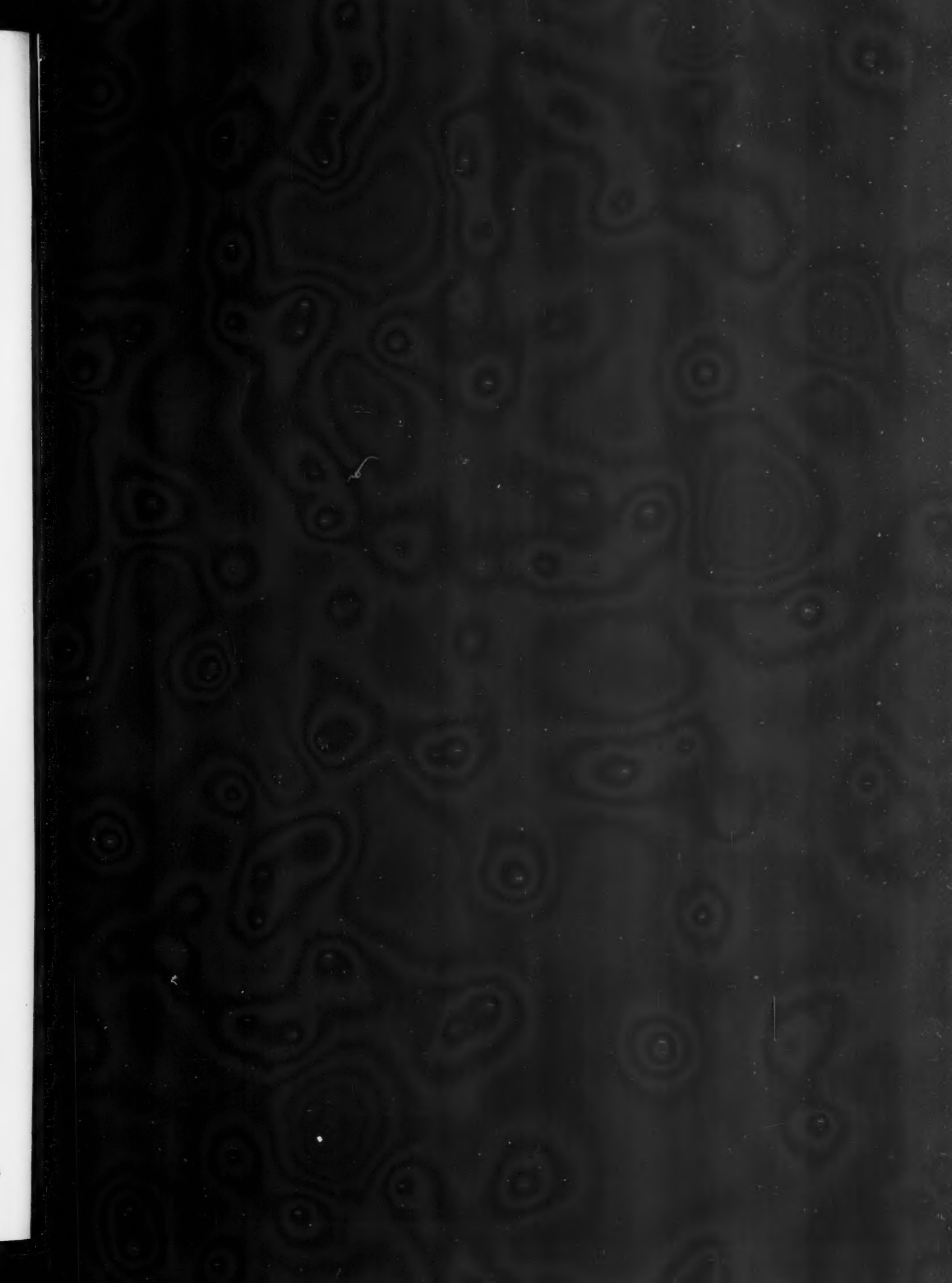

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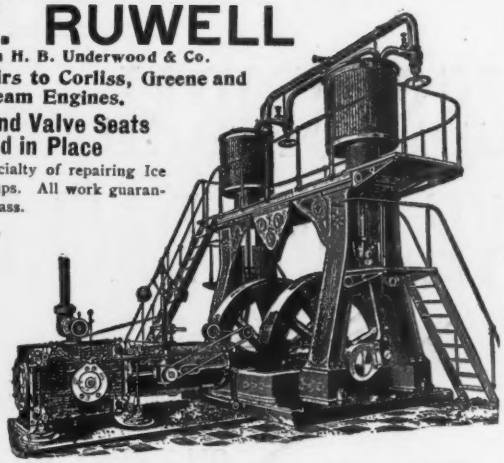

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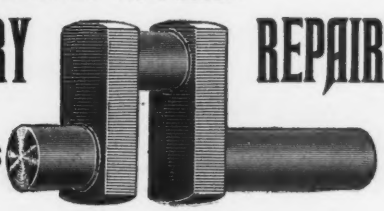

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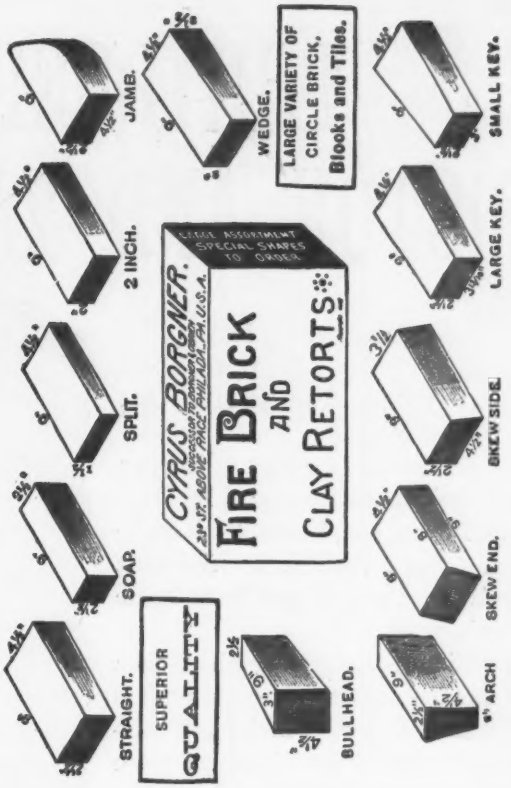

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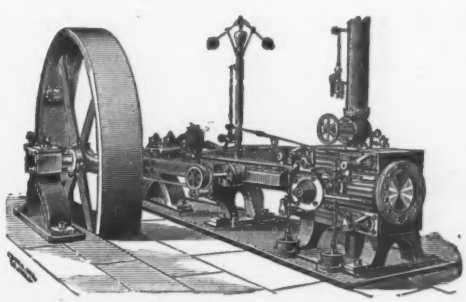

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THE PEERLESS SPIRAL PISTON AND VALVE ROD PACKING

ESCANABA, MICH.,
Sept., 16, 1901.
THE PEERLESS RUBBER MFG. CO.,
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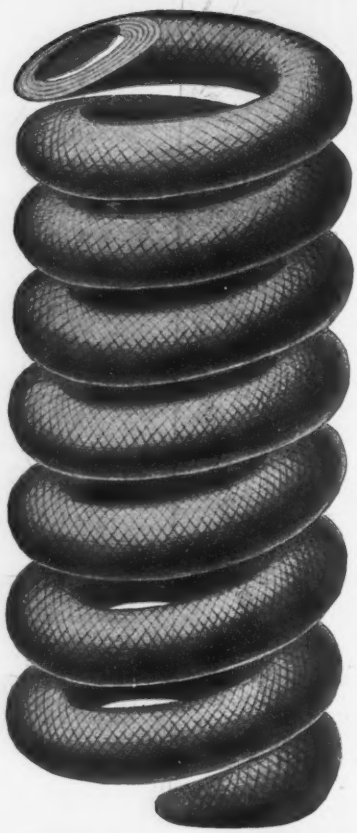
SIRS:—I wish to give you my testimonial in regard to Peerless Piston and Valve Rod Packing. Have used it for the past twelve years and put it to some severe tests.

While in charge of the Escanaba & Gladstone Transportation Co.'s Steamer "Lotus," which has a compound engine and steam at 140 lbs., we ran 22,000 miles on a single packing.

Congratulating you on the success of the same, and assuring you that I shall always recommend it when I possibly can, I remain,

Yours truly,
ALFRED LARSON,
Chief Engineer, Escanaba Water Works



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The Practical Engineer

THE
OFFICIAL ORGAN
OF THE
AMERICAN ORDER
OF STEAM ENGINEERS

Devoted to the Interests of Stationary Engineers.

VOL. VI. PHILADELPHIA, APRIL, 1902 NO. 3

Long Distance Transmission of Electrical Energy.

Elsewhere in this edition we publish an article upon methods of transmission of energy, showing the great possibilities in that of electricity; so great are these possibilities in fact that one of the largest steam railroads in America (the Great Northern) has appointed a special committee to examine the latest electrical devices for this purpose, and to make other investigations tending to the equipment of their road with the electric mode of transportation to replace their present method. It is their intention to utilize for generating purposes the numerous water falls which abound along their system.

This is indeed a remarkable undertaking and undoubtedly it will be fraught with many obstacles which must be overcome before the ultimate success of the project is assured.

The trials and troubles not to count the delays caused by inclement weather must be reckoned with, just how great and varied these are can be judged from those which daily occur on our local trolley lines. Thus it will be seen that although the possibilities of electricity as a motive power are alluring in the extreme yet there are many obstacles to be overcome before there can be any possibility of its superceding steam on our great railway systems.

It is true that with the adoption of the third rail system a great stride was made in the matter of overcoming, to a certain extent, the losses which are induced by the use of the overhead system; in the winter time through the wires becoming ice coated, and in other seasons by wind storms tearing down the wires, etc., but so far as we can see there is no possibility of any of our trunk systems making the attempt to install such expensive machinery, as would be necessary to accomplish anywhere near their requirements, until the above points have been clearly settled and positive demonstration made of the utmost reliability of the system.

While we do not disparage or underestimate the great value of the subtle fluid as a power, yet undoubtedly it will be some years before the steam throttle can with any degree of stability be surrendered to the electric switch, in the matter of long distance travel, or in the moving of heavy freight.

Thus it will be seen that there need be no apprehension upon the part of the steam engineers of the Great Northern Railway, or any other of our principal roads concerning their positions. That there is great power to be derived from our numerous water falls in the matter of electrical generation is true, but the assumption that this power can be distributed with the proper degree of economy to any great distance is as yet—problematical.

Engineers and Engineering Journals.

Probably one of the most important features of Twentieth Century enterprise and success is being displayed daily by the trade press or technical journals; the time has come when they have to be considered a part of the necessaries of the craftsman in whatever line he may be employed. Their status in their own field is analogous to that of the daily newspaper. The latter gives an account of the occurences in the political and general life of the public; the former, especially the engineering journal, discuss and delineate the occurrences which take place in the industrial arts throughout the entire civilized world.

There is not a doubt, that the rapid progress made in the trades and mechanical professions during the past quarter century is due, in a very great measure, to the enterprise and progress of the journals, presenting as they do the knowledge, both theoretical and practical, of the doings of the world's brightest minds, and in this way disseminating knowledge and information, heretofore practically unattainable, among a large body of interested readers.

Suppose some new invention of merit be made or some

brilliant discovery announced, it is at once made an especial feature by this or that journal reaching the people whom such a device or appliance will most benefit, where it will in all probability be discussed and improved in many ways.

In this manner the efforts of the few are presented to the many to their mutual benefit, and knowledge of the greatest possible importance is thus disseminated throughout the world.

To the engineer who is anxious to advance in his chosen profession, no greater opportunity presents itself than a study of the many efficient publications analogous to that profession. Through their efforts in collecting and publishing information, from a multiplicity of sources, he is made acquainted with the latest and best methods for doing his work, as well as with the newest devices and appliances appertaining to his profession, almost as soon as they are out. Thus one must see that the man who makes a study of such works will be benefitted in an untold degree.

By learning what others are doing, who are engaged in work similar to his own, he is enabled to increase upon and improve his own ideas and inventions and greatly add to the general efficiency of his particular plant or engine room, and in that way command for himself not only the respect and confidence of his employer, but in many cases the opportunity of securing a good financial return for his efforts and studies.

The time has passed when narrow-mindedness controls the actions of the engineering classes; let them emulate the members of other professions in their examples, when a doctor, lawyer or civil engineer makes a valuable discovery he immediately gives his fellow craftsmen, in part at least, the benefit of it, for experience has taught him that liberality in such matters will come back with interest.

The success of all in any walk of life will always benefit the individual, this has been proven in the so called higher professions where the interchange of ideas prevails so successfully and should maintain as well in the engineering classes.

Every engineer then whose thought is to succeed must be prepared to give and take, this will enable him to freely avail himself of the knowledge of his fellow workmen and profit by it.

In following out this policy of expansion he should not only be a diligent student of, but also a contributor to those journals in which he is interested and in doing this he will find an advancement and success greater than he has anticipated, besides he has the contentment resultant from knowing that he has added his mite to the aid of his fellows who may not have had the opportunity to advance as rapidly as himself.

Undoubtedly to the trade journal is due the present advanced position of the engineering profession, and again we repeat, do not hesitate to aid it in every way for therein lies the very essence of your power.

The dollars and hours spent in this way will return a hundred fold, for in no other line is there such an opportunity for elevating and establishing a solid and substantial profession as in that of steam engineering.

Efficiency and Economy.

These two terms are used so frequently, and in such close relation to each other that they have, in the minds of many, become synonymous. It is true that in many cases a high efficiency denotes a high economy but the relation does not always hold.

For example, should a small mill owner decide to remodel his business, and instead of a variable and rather unreliable water supply to install a steam power plant, it would be to the interest of high efficiency to set up a small compound engine with all its auxiliary apparatus, and to put in mechanical stokers under the boilers, with perhaps automatic conveyors for the coal and refuse.

But when it comes to a question of economy, it is a wholly different matter. The apparatus will do economical work, but it will not be an economical plant. In the first place there is the interest on the investment in the high-priced engine and boiler plant. Added to this there is the loss by wear and tear to the same, and in case the attendance should not be of the best this is not a light one. So that after all the owner may find it more economical in the long run to purchase an engine and boilers of less efficiency and to do his firing by hand, and to be certain that even though his plant is not receiving the most skilled attention, it is keeping up very close to its first performances, while the depreciation in value and the interest on investment are falling far below that which would have accompanied the use of the higher priced machinery.

That would be one example of uneconomical efficiency. But there are many others. No sane man, or at least no one who has any knowledge of the rudiments of steam engineering, would think of putting in a battery of good boilers and then allow the steam main to be carried away to the point of application of the steam uncovered and unprotected in any way.

While the case cited is only an illustration, and very probably not an actual fact, yet there are plants in operation which show certain signs that very much resemble this saving at the spigot and wasting at the bunghole. And the instance of this which follows is real, and can be found by almost anyone who cares to make a search for its likeness.

It concerns a refrigerating and ice-making plant in which are installed two modern ammonia compressors driven by compound condensing Corliss engines. These engines have a water rate of a little more than eighteen pounds per horse power per hour.

Now, right on the same floor with these engines, working side by side with them, are several direct-acting duplex steam pumps, used for pumping the condensing water as well as the brine. These pumps, carrying steam full stroke, use about 200 pounds of water per horse power per hour.

The question arises, is this actual economy? Why should

there be such a desire to save in the steam consumption of the engines, and such an utter disregard of steam consumption in the case of the pumps? Why would it not be cheaper to install an engine of ample power, and even of a greater water rate than the others, and by the use of power pumps driven from this engine to do away with the acknowledged wastefulness of the direct-acting steam pump?

This would not apply to the absorption system. For in that case the exhaust would be run to the stills, so that the heat would all be utilized—heat which would have to come from the boiler in any event, whether the pump were used or not.

The Physical and Chemical Properties of Water.

By T. H. Reardon.

Water, the most familiar of all the substances with which we are acquainted, is a chemical compound in which one part by weight of hydrogen unites with eight parts by weight of hydrogen to form that clear, transparent liquid which every one will acknowledge is more of a real necessity than any other article known to mankind. As familiar as this substance is, it is the writer's experience that comparatively few have a knowledge of its simpler properties.

Take, for instance, the boiling point of water; probably the majority of people will tell you that water boils at 212 F.; which it does, in fact, under certain fixed conditions, namely: at sea level and mean barometrical pressure of 14.7 lbs. per square inch, but those conditions must exist or be produced.

The above conditions may exist and still the boiling point may be at variance with the figures given; other conditions must be considered. If the water contains any solid matter in solution the boiling point will be above 212 F., and the freezing point below 32 F. Taking a saturated solution of common salt as an example, the boiling point will be found to be about 230 F., while the freezing point will be about 4 F. above 0°; with a saturated solution of chloride of calcium, a substance that is largely used instead of the older salt solution in refrigerating plants, the boiling point is about 356° F., and the freezing is several degrees below zero.

It will probably sound paradoxical to say that water can be made to boil at its freezing temperature 32 F., but nevertheless it is a fact that has been repeatedly demonstrated. To make water boil at this low point it is only necessary to have a good vacuum pump, such as may be found in any well-equipped laboratory. As soon as the pressure on the surface of the water is brought down to .08 lbs. absolute the water will be in active ebullition. The effect of solid matter in solution in lowering the freezing point having been treated, the influence of other conditions in depressing the freezing point will be considered. Water always expands in freezing, but it is not generally known that if expansion is prevented water cannot freeze.

Experiments to prove the above statement were made many years ago, the water being confined in a vessel of enormous strength and some small metal balls were inclosed with it, so that by rolling the containing vessel the movement of the balls could be heard, thus proving that the water had not solidified, the most intense natural cold having prevailed during the experiments. Upon giving vent to the vessel in the above experiment, and thus relieving the enormous pressure, the water froze immediately. Another very curious condition that lowers the freezing point is the fact that if water is enclosed in glass tubes of extremely small bore the water may be cooled several degrees below 32 F. without assuming the solid state.

The writer has never seen any explanation given for this last-mentioned freak of water, and recommends it as a subject for discussion when other topics become scarce.

The elevation of the boiling point, due to an increase of pressure, is a matter that is worthy of notice. Reference to the steam tables will show the influence of pressure on the boiling point, it being apparent from an inspection of the tables that water might have a temperature sufficiently high to melt lead, and yet the water is not boiling. The only requisite essential to success in obtaining the above condition is that the containing vessel should have sufficient strength to withstand the pressure of saturated steam corresponding to a temperature of 620 F. The resolution of water into its components, namely, hydrogen and oxygen, is a matter that is of more interest to the chemist than to the engineer, but as there are many notions about the decomposition of steam and the formation of a gas due to excessively high temperature, as, when crown sheets or tubes become red hot, due to low water, it may be interesting to know that steam has been excessively superheated, with a view of ascertaining its stability under the condition of an enormously high temperature.

Steam passed through porcelain tubes, heated to redness, has shown no signs of decomposition, but when subjected to a full white heat it has been somewhat imperfectly decomposed, its component gases separating, only to quietly unite again as soon as a slightly lower temperature rendered this latter condition possible. Another important property of water, that to a certain extent engages the attention of the engineer, is its solvent action. There is no other single agent that is capable of dissolving so many different substances as water.

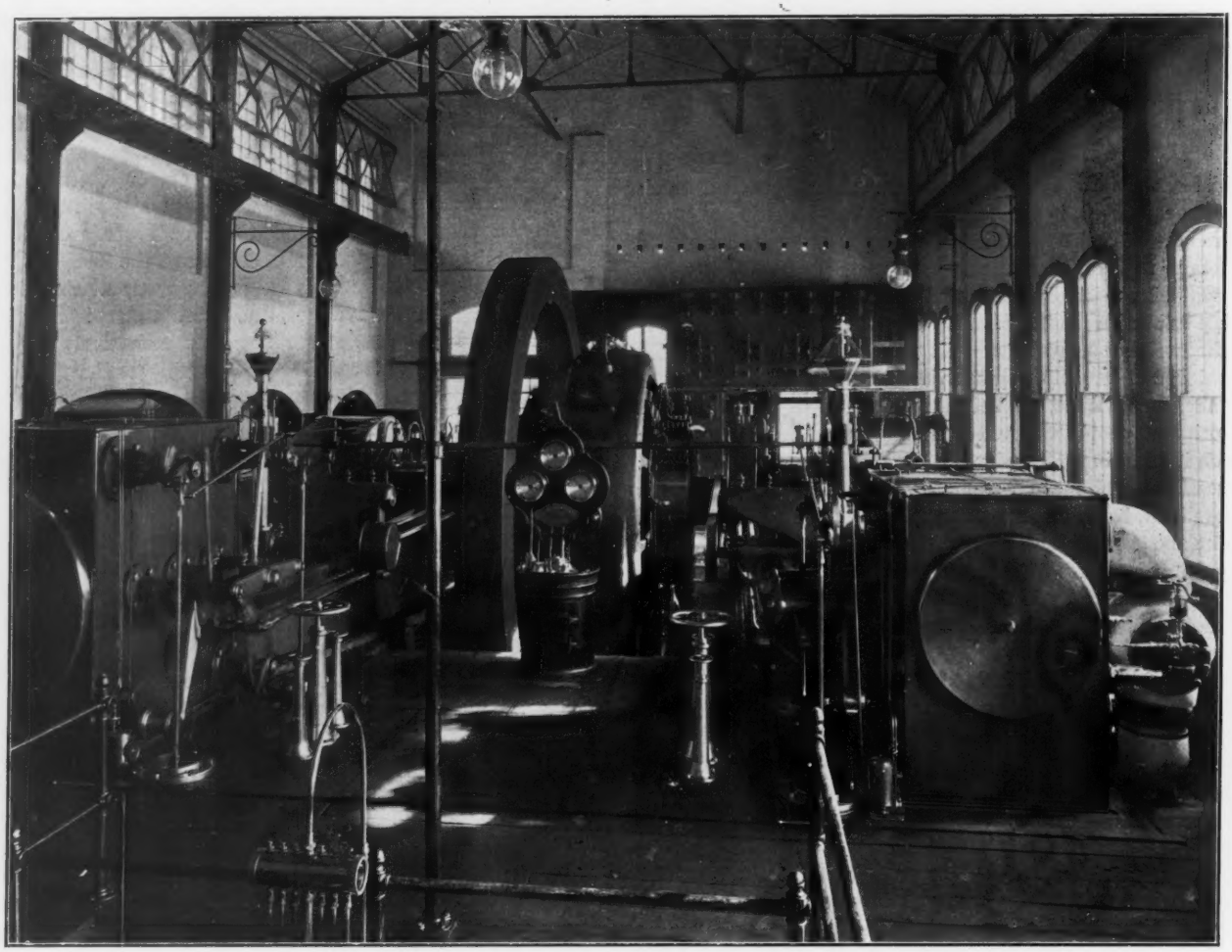
As a general rule, solid substances are soluble to a much greater extent in boiling water than in cold water; there are, however, some notable exceptions, and it is this particular fact that makes much trouble for steam users. When the solubility of any particular substance is lessened the excess of that substance in the liquid will have to deposit, and in the steam boiler this deposit constitutes the scale that is a source of much annoyance, inefficiency, and quite frequently is the cause of actual damage. The salts of calcium and magnesium, particularly the carbonates and sulphates, are much less soluble in hot than in cold water. It is this fact that causes the deposit to take place.

With gases the conditions favoring solubility are just the reverse of what they are in the case of solids. One volume of water at nearly the freezing point will absorb over 1100 volumes of ammonia gas, the solubility decreasing with higher temperature until the boiling point is reached, which, if maintained, will absolutely expel the gas from the water. While the conditions noted above are objectionable in certain operations, yet the same conditions are of much use in the arts, as it is by means of their different solubility that many substances are separated from each other in their commercial production.

The diameter of the steam supply pipe should be about one-fourth the diameter of the piston.

The Evolution of the Camden and Suburban Power Station.

Nowhere in the United States is one more likely to see greater evidence of the rapid and splendidly successful evolution of electricity, than at the power house of the Camden & Suburban Railway Company, Cooper's Creek, Camden, N. J. This Company was among the first in America to install the trolley system of transportation; using at that time the expensive double overhead wire and double trolley device, which is now long since obsolete.



1200 Horse-Power Cross Compound Condensing Engine, Corliss Type—Camden & Suburban Power Station, Camden, N. J.

Unless brought face to face with such a plant one can scarcely realize the great strides made in electrical transportation methods during the past fifteen years. During that space of time the Camden Company has grown rapidly; from a single 100 Kilo Watt generator, with its primitive accessories, to a magnificant plant of 3,000 horse-power with a multiplicity of appliances, all adding to the general safety and convenience of the Twentieth Century traveling public.

With the first inception of the plant the Company decided to use power from a nearby electric light station. This was soon found to be wholly inadequate, so quickly did the trolley car spring into public favor; they then built what was the neucles of their present plant. There they installed one of the old style Kilo Watt Edison Bi-Polar generators and belted it to a Westinghouse compound engine; cylinders, 10 inches by 20 inches by 10 inch stroke.

It was but a short time until it became necessary to increase their power. This was done by installing a duplicate of the above engine and generator. These engines were connected to a Worthington jet condenser, 7½ inch by 10¼ inch by 10 inch stroke.

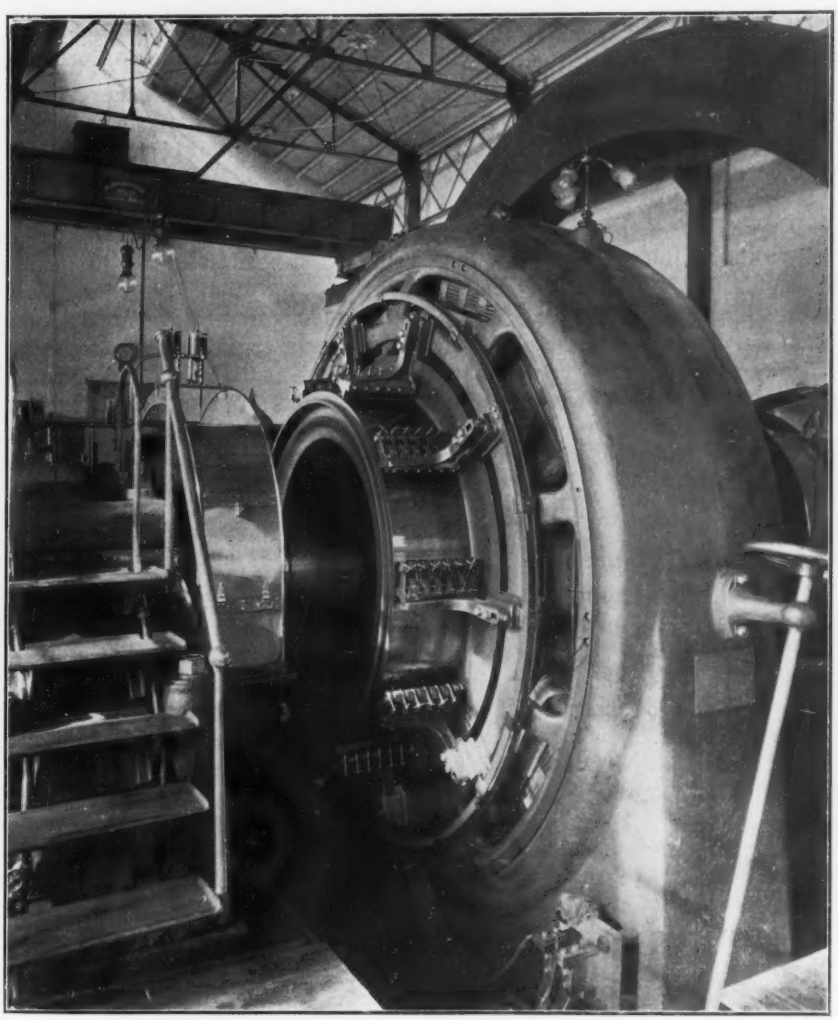
Following this the next increase in power was obtained from a simple horizontal Ball engine, 18 inch cylinder by 20 inch stroke, belted to a 200 Kilo Watt General Electric Multi-polar generator. This was later increased with two vertical Cross Compound Ball engines, 16 inch and 28 inch by 18 inch stroke, belted to two Westinghouse Multi-Polar generators; one 180 Kilo Watt and the other a 225 Kilo Watt. These two engines were each connected with a Knowles jet condenser, 9 inch by 16½ inch by 10 inch stroke.

To further augment the efficiency of the plant the Company installed a four-pole 600 Ampere Compound wound Booster, manufactured by the General Electric Company. This is directly connected to a four-pole 50 horse-power General Electric motor, running at a speed of 600 revolutions per minute. This is operated in connection with a storage battery made by the Electric Storage Battery Company, consisting of 264 cells of type F. chloride accumulators; these are worked in connection with the dynamos and in series with the Booster.

Steam to operate the above mentioned engines is supplied by six return tubular boilers of 125 horse-power each, manufactured by the Coatesville Boiler Works, Coatesville, Pa. The feed water is taken both from an artesian well and adjoining creek. The boilers are fed with one duplex pump, manufactured by the Barr Pumping Engine Company, Philadelphia, Pa., and by two Knowles Vertical Marine type.

The rapid growth of the road has necessitated the installation during the past year, in addition to the above mentioned apparatus, an independent system working in connection with the above, and composed of the most complete and efficient electrical devices and apparatus known to modern electricians. The accompanying illustrations show both the generators and engines used in their latest acquisition.

The engine is of the Cross Compound Condensing Corliss type, built by the Pennsylvania Iron Works, with the cylinders 30½ inch and 52 inch diameter, stroke 48 inch, it is rated at 1,200 horse-power. The cylinder ratio is $2\frac{9}{16}$ from low to high,



800 K. W. Westinghouse Direct Coupled Generator

and is so connected that it can be run independently on either side.

Between the high and low pressure cylinders, forming an integral part of the engine design, is located a large receiver fitted with live steam reheating coils. This engine is direct connected to a 10-pole 800 Kilo-Watt compound wound generator, manufactured by the Westinghouse Electrical Company.

The engine is supplied with steam from two boilers of 300 horse-power, each of the Berry type, manufactured by Robert Wetherill, Chester, Pa., in connection with the return tubular boilers of the old plant.

The whole system is lubricated by an efficient oiling system of the gravity type which was designed by the Company's chief engineer.

For heating the feed water they have two feed water heaters, a primary and secondary, manufactured by the Goubert Heater Company; one is of the vertical type and is located in the boiler room, through which all of the auxiliary exhaust is trained and has a capacity of 1,500 horse-power. The other is of equal power and is located between the low pressure cylinder and condenser, through which the direct exhaust of the engine is trained, the feed water passing through them both in series and is set horizontally.

Original with this plant is a single pole board, designed and constructed by Mr. H. A. Johnson, Chief Engineer. This board consists of an upper and lower deck all of unpolished slate panels.

These panels on the lower board contain the generators, each having a separate panel of its own, the lower board also contains the battery and booster panels. The general construction of this board is so different and has so many radical changes to that usually adopted by electric railways that THE PRACTICAL ENGINEER will in a later edition more clearly delineate its features.

It is of especial value where urban and interurban travel is to be accommodated with direct current lines. The generators are joined to their respective machine panel from positive side of machine, thence to breakers in multiple, then by means of a double throw switch any machine may be put into service upon either bar, which are operated at different voltage, and any feeder can, by the means of a double throw switch, be separately connected to either bar; this gives the opportunity of supplying the extreme suburbs with a higher voltage, thereby reducing greatly the amount of copper usually necessary to obtain the same results.

The switches are of the General Electric Quick Break pattern; the breakers are of the General Equipment Co. type.

There are many electric power stations scattered throughout the country, but to none other is the public indebted so much as to this place. In the front ranks in that line in the beginning the Company have ever been willing to use their every endeavor to keep it there, both in the matter of equipment in their power plant, and in their adoption of the very latest devices obtainable in their rolling stock.

The Evolution of Methods of Transmitting Energy.

It is a well known fact that energy of one form cannot be transformed into energy of some other specific form without a loss in the efficiency of the transforming apparatus. The less this loss the more perfect the transformation device is considered.

When the mechanical energy of men was the only means of conversion of power, the efficiency was probably at the lowest point and the cost of such power at the highest. Some of the monuments of engineering that are found in the far eastern countries were erected largely by means of animal power, and bear testimony to the wonderful achievements of the ancients with, what we consider to-day a very small amount of power.

The energy in rapid streams, waterfalls, and air currents in the atmosphere was the first energy employed by man as a substitute for animal power. Up to the period of the practical perfection of the steam engine by Newcomen, Watt, and others, the energy required for manufacturing industries was practically supplied by water-power, and the conversion was by means of water-wheels, and the transmission by line shafting, gearings, and belts. This condition forced the location of the mills and factories close to the source of power; and consequently we find that the manufacturing centers were limited in numbers and extent.

The advent of the steam engine marked an epoch in the development of manufacturing industries such as the world had never before witnessed, not only in the number of the industries, but also in their size and importance. It was no longer necessary to carry the raw material long distances to the mill or factory; but where fuel was available, a mill or factory was started in close proximity to the supply of the material, and the impetus thus given to the development of the whole civilized world has extended to our times, so that this age can justly be called the "Manufacturing Age".

Considering steam generators, the improvements in boiler practice are in the construction of the boiler, and in the ability to install greater power in a given space, although there has been no decided advance made in actually increasing the efficiency. It might be interesting to note that there were no advances and practically no use made of boilers from the time of that described by Hero of Alexandria, about 200 years before the Christian era, to the seventeenth century. One of Watt's earliest boilers was made of wood with a metal fire-box. When this is compared with the modern boiler, it shows that the advances that have been made are largely in the ability to increase the pressure in operating the boilers.

The advances in the steam engine have been in the improvement of the valve gear by Corliss and others, and the compounding of the cylinders, and more recently in the use of superheated steam. The use of superheated steam cannot be said to be a new development, although its successful adoption has only taken place within the past few years. In the early trials great difficulty was experienced in the cylinder lubrication, as at that time it was necessary to depend on animal oils for this purpose. With the use of petroleum lubricants, this difficulty has been largely removed.

A number of manufacturers have recently been devoting their efforts to the development of the steam turbine, and the efficiencies which they have obtained on tests show that even with comparatively small units they are nearly able to equal the best results that have yet been obtained with reciprocating steam engines. The advantages of the steam turbine over the steam engine are primarily a great reduction in the size of the machine for the same output and a reduction in the first cost.

But while all these improvements in the formation of energy have been passing a successful evolution, so to, have methods of transmission of this energy.

Considering the transmission system the early examples consisted of systems of gearing, line shafting belting and ropes. These are expensive both in the first cost and in the cost of operation. The efficiency in many cases was exceedingly low, the power required to operate the transmission system often exceeding the power actually required for manufacturing purposes. The longest distance to which power could be transmitted was limited to one or two miles. Rope transmision was largely used for transmitting power to operate street-cars and for hauling purposes in mines. The complications and the unreliability of the old cable tramways are well known to all of the older residents of Philadelphia, and many other cities.

Compressed air has long been used for the transmission of power, particularly in mines. The economy of this transmission for limited distances is fairly high, and in mines it has the double advantage of supplying fresh air to the mine workers. The development of its use in manufacturing plants was retarded for a long time on account of the lack of the proper development of consumption devices. A number of such devices are now produced, and the utilization of compressed air for various purposes has largely increased, notably its use in machine shops for the operation of tools, for painting, and for cleaning purposes. The limitations to long transmission are due to the expense of construction, necessitating the use of large pipes. There is also a serious loss in this method of transmission owing to the large amount of heat that is generated during compression. Difficulties have also been experienced with the freezing of the exhaust at the consumption device. These, however, have been overcome by reheating the air before reaching the consumption device.

Steam has been used for long distance transmission, but the condensation and the maintenance of the pipe line and the heavy first cost have prevented its commercial success.

A number of papers have been written concerning the use of coal gas for power purposes, the gas being produced at the mines or at a point close to the coal fields and transmitted to the points of consumption by means of a pipe line. We have no knowledge, however, of this being attempted, or any long distance transmission of coal gas. The requirements of all of the consumption devices, either gas engines or burners (when the gas is used for heating purposes), necessitate that the gas should be delivered at a low pressure. It is possible, however, that the gas can be transmitted at a high pressure and reduced to a low pressure before reaching the point of consumption. There are, however, a number of practical objections, one of which is the increased leakage with increased pressure; and these difficuties seem to have been great enough to prevent its commercial success. A paper by Wm. C. L. Eglin, recently read before the engineers Club of Philadelphia contains much interesting information upon this subject, a part of which is contained in the following.

The advantages of electrical transmission of energy were quickly appreciated by engineers, the only loss in transmission being that in overcoming the electrical resistance of the conductor; and as the electrical resistance of most of the metals

is comparatively low, cheap conductors were readily obtainable. The insulation of the conductor was the part that required the greatest study, and this is constantly being improved. The difficulties to be overcome in securing practical insulation were many. The materials which formed good insulating media had poor mechanical qualities, being either of a low tensile strength or of a brittle character, so as to crack by bending or jarring. By subdividing the insulation into a number of layers and parts, and by combinations of materials, it is now possible to insulate for extremely high pressures. One of the characteristic phenomena of an alternating current is that it can be transformed from a low pressure and large volume to a high pressure, and small volume by means of stationary apparatus, with a very high efficiency ; modern transformers of this class exceeding ninety–five per cent. By this means the engineer is able to arrange his transmission system so as to obtain the maximum capacity with a minimum size of conductor, which is essential in long distance transmission.

When the current is to be transmitted short distances, the advantages of a high pressure are not so important, and the controlling feature is usually the pressure at which the motors or consumption devices can best be operated. When the energy is to be delivered to a large number of motors or consumption devices distributed throughout a limited territory, there are advantages in using the direct current instead of the alternating current for this purpose. This is due principally to the developments which have been made in the consumption devices. Direct current motors start more easily, the speed can be readily controlled, and they are more economical in their first cost. Arc lamps operate better and more efficiently on direct current. The energy can be stored by means of storage batteries, and this current is at present being used for a larger variety of purposes than the alternating current.

In the early use of the alternating current the principal drawback was the excessive lagging of the current behind the pressure, caused by the introduction of a reactive material in the circuit. This necessitated the transmission of a larger current for the same energy, and a consequent increase of loss, than would have occurred had the current and voltage been more nearly in step. The real energy in a circuit having a lagging current is not represented by the product of the current and the voltage, but is a smaller quantity ; and the ratio of this quantity to the product of the current and voltage is termed the power factor.

In the early systems this power factor was frequently as low as sixty per cent. With the more recent developments this efficiency has been increased to eighty per cent. or higher, and by the introduction of synchronizing apparatus,–that is, motors operated with separately excited fields, which maintain the uniform and in step rotation of the motor and generator,–the power factor can be made one hundred per cent.

This means of transmitting energy with such a comparatively small loss, as compared with former methods, has caused a tremendous stride in the limits to which energy can be transmitted. . Most of the failures and troubles have been caused by poor construction. On account of the high efficiency in electrical transmission there should be no reason or excuse for poor construction.

The utilization of the tremendous power at Niagara Falls and many other hydraulic developments have been made possible by the use of electricity for transmission purposes. On account of the extravagant use which man has made of the fuel supply it is very gratifying and encouraging to see that the other natural sources of power are being developed. It has been stated that the power available at Niagara alone is equal to the whole coal supply of the world.

We now come to the consideration of the third head, the motors or consumption devices. When the power was transmitted by means of shafts, belting, or ropes, the only question that required consideration was the proper size of the pulley or coupling to transmit the load, with the exception of machines that required variable speed. The variations in speed in such machines were usually accomplished either by means of cone pulleys or by a slipping clutch.

With the advancement in the transmission system by the use of compressed air, steam, or electricty, it was necessary to provide some means of converting the energy into the form required by the machine used in the manufacturing industries, In the case of steam transmission a great number of designs of special engines were made to suit the variety of work they had to perform. Steam engines had the desirable qualification of being easily varied in speed, close–governing, and reversible.

With compressed air there were some difficulties in designing motors of large size, but with small units it had been used successfully, and there is now being manufactured by a variety of manufacturers a complete line of motors and hammers, and their use is very general in modern machine shops. The exhaust, being fresh air, has the advantage of improving the ventilation and obviates the necessity of an exhaust pipe, which has to be used in a steam engine. The speed can be varied and the motors can be reversed. In most of these devices there are a number of wearing parts that require adjustment and attention. Considering electric motors, there are two distinct types of such motors, viz.: direct current and alternating current motors. The alternating current motor is possibly the simplest from of motor which has yet been devised, one design consisting of an iron body revolving in an air space without actual contact at any point except the shaft bearings. The majority of the smaller motors, however, are of the class known as induction motors. In this case the rotating part consists of a laminated iron cylinder with copper conductors embedded in the surface, these conductors being short–circuited at each end. There is no direct electric connection in this moving part, the current being induced in these conductors from the stationary coils which surround the conductors. These motors are operated from a multiphase circuit, usually either two–or three–phase. They can readily be started, either by means of a special transformer, reducing the pressure impressed on the surrounding coils, and increasing this pressure as the motor approaches its maximum speed, or by introducing a resistance in the circuits which are embedded in the movable part, this resistance being made variable, so that it can be reduced in steps as the motor increases in velocity.

All alternating motors must be run at a constant speed, the speed depending upon the frequency of the alternations of the current delivered to the motor, so that when variations are required, they must be provided by some mechanical means.

All of these motors have a starting torque of two or three times the full running torque, and there is therefore no serious difficulty in starting under load. It can readily be appreciated that a motor of almost ideal simplicity in its moving parts would require the minimum of attention.

Direct current motors have been more universally used, first, on account of their earlier development and the lower cost, and,

second, on account of their ease of control and the ability to operate at a comparatively high efficiency with a varying speed. The control of this motor is probably the most perfect of any device that has yet been produced, as the speed can be increased from zero to maximum and maintain at any intervening point with a uniform torque and a very high efficiency. Both types of motors can be readily reversed. The direct current motor has the disadvantage of using a commutator on the moving part with sliding contacts. Since the introduction of carbon brushes, the commutators are designed with more ample proportions, and this feature now requires very little attention, more nearly filling all the requirments of the manufacturing arts than any form of motor yet produced. There are special cases, however, where it is not adaptable, as when the sparking at the brushes could ignite inflammable or explosive gases or material. Even these, however, can be overcome by entirely enclosing the revolving part. Many machines of this form are now designed to keep out dirt and dust, such as street-car motors, automobile motors, and motors used on machine tools.

There are practically no limits to the sizes to which this machine can be built. It can be made from a fraction of a horse-power to several hundred, with efficiencies averaging above eighty-five per cent. at full load and seventy per cent. at half load.

In considering the fourth head, namely, the load factor of the entire plant, it has already been shown that practice does not permit of constant operation for twenty-four hours per day at full load, some time being lost by repairs and the attention required by the various machines. The nearer, however, the approach to this ideal, the higher the economy of the whole plant will be, and this would demand the most efficient apparatus possible to be used throughout the entire system. As we recede from this point to a minimum load, the necessity for higher economy and expensive apparatus is not so important. A heavy load for one or two hours per day cannot be operated economically by the very best types of apparatus, first, on account of the necessary preparation to operate this load, and, second, the inability to utilize the labor for the full term of the working day, and also the large loss in keeping this plant ready to be operated during one or two hours of the following twenty-four hours, the interest and depreciation charges being the same, irrespective of the output of the plant. It is frequently the practice for this class of work to employ the cheapest grade of material, as the difference between the interest and depreciation charges will more than offset the losses caused by lower economy. Loads of this character are, however, not general, although there are a very large number of plants which must be operated at excessively high loads for a short period during the twenty-four hours, or, as shown by the load diagrams with a very high peak load.

The variations in the load diagram are questions that should be most seriously studied, so that they can be reduced as much as possible, and as it has been shown that motors or consumption devices can be subdivided into the smaller units required, the obviating the necessity of running any idle mahinery, allowing the generating apparatus to supply the average demand and a consequent smooth load diagram free from any violent fluctuations.

The Simple Telephone.

By Arthur Atwater Kent.

Although the simple telephone, transmitter and receiver, can be understood more readily than almost any other piece of electrical apparatus, thousand of people who are versed in other branches of the electrical industry know nothing about the principles of the commonest of instruments.

It is not my purpose to make a long explanation of the telephone, for that would never end, so great and complicated are the numerous systems for connecting, ringing, avoiding trouble, etc.

The talking part is the simplest and most interesting, and it is this that I will explain. A conversation may be carried on at a distance by the use of two transmitters and two receivers at each end, a single battery and wires to complete the circuit.

The transmitter consists of a metal diaphragam. A, (Fig. 1) about 3 inches in diameter, which is vibrated by the sound of the voice, two carbon buttons or plates B, B, about ¾ of an inch in diameter, one fastened to the vibrating diaphragm A, and the other to the back of the transmitter, D. Small carbon granules, C, are placed between the two discs and held there by a thin piece of very flexible felt encircling cylindrically the two carbon discs. These are the vital parts of the transmitter ; the case, D, is usually made of brass and the mouth piece, M, of hard rubber. The current from the battery enters by the wire E, passes through one carbon plate B, through the carbon granule C, through the

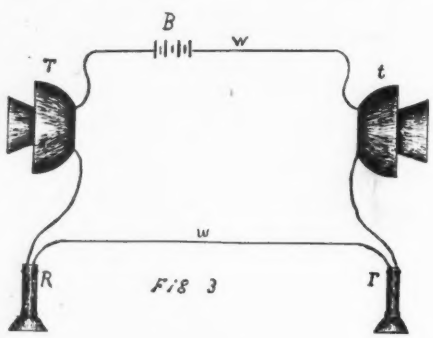


Fig 3

other disc B, and out by wire F. As the diaphragm A is vibrated by the voice the carbon granules are alternately compressed and released. When they are compressed they offer only a small resistance to the current from the battery, and consequently a large current will flow through them, but as they are released the resistance is increased, only a small current will flow, so when a sound vibrates the diaphragm a current constantly varying in strength is passing through the wires. This undulation of the current corresponds with the vibrations of the diaphragm and, in turn, of the voice.

The receiver is fully as simple as the transmitter, its vital parts being a coil, C, (Fig. 2) of fine wire wound around the end of a permanent steel magnet, B, and a soft iron or soft steel diaphragm, A. The case around this is usually of hard rubber. The magnet B acts as an iron core for the coil C, and is magnetized to hold the diaphragm A at a slight tension, although this magnetism does not effect the action upon it of the current of the coil. The two wires at the ends of the coil are connected to the wires leading from the transmitter at the other end of the line. Thus it will be seen that the same undulated current that passed through the transmitter now passes through the coil C and vibrates the diaphragm A of the receiver in a manner cor-

responding to the vibrations of the diaphragm of the transmitter. We have now two diaphragms vibrating exactly alike, so the sound of one must be the same as the sound of the other, or the sound produced in one will be reproduced in the other, and the voice is carried over the distance traversed by the connecting wires. For two people to carry on a conversation we must have a transmitter and receiver at each end.

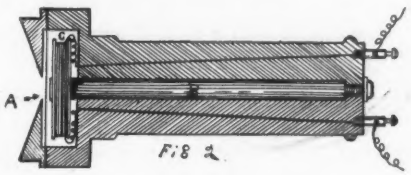


Fig 2.

Reference to Fig. 3 will show the manner of connecting the talking circuit. R and R are the receivers; T and T are the transmitters; W and W are the wires connecting the two instruments and B is the battery. All are connected in series so that the current from the battery will pass through each instrument in succession.

This apparatus, although very simple, will carry the voice as well as the most complicated piece of apparatus that was ever made. Any additions to this are simply for ringing, avoiding outside disturbances and various other uses known to telephone station men.

When a calling system is used, whether the magnets and bell or push button and vibrating bell, a switch is connected to the lever on which the receiver hangs that changes the wires from the talking circuit to the ringing system when the instrument is not in use. Everything is now in readiness for the next and when the receiver is removed to be placed to the ear the levers throw the wires back on the talking circuit.

At one time it was the universal custom, and now successful on short lines, to use a ground return made simply by attaching the return wire to the gas or water pipe at each end, this saved wire and the cost of construction, but since the introduction of street railways and alternating systems of electric lighting the confusion of disturbing currents have compelled almost all systems to use the "metallic" circuit, or two wires.

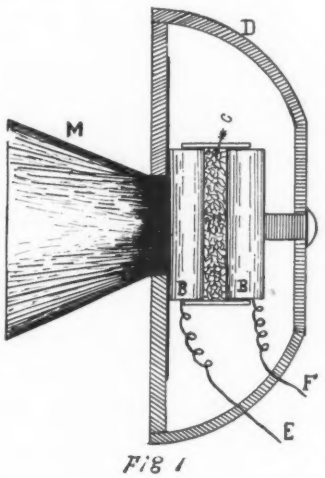


Fig 1

There are two distinct classes of ringing; one is the ordinary push button and vibrating bell, which is the cheapest and almost universally used for small factory systems and short lines. The other is the magneto system, which is sub-divided into almost innumerable, so many that hardly a week passed that the U. S. Patent Office does not grant a patent for some new system, either good or otherwise.

There is another method used to call the telephone operator in what is called the central energy system. In this method, when the subscriber takes the receiver off the hook he makes a circuit which carries a small current to the central office. This current works a relay, which in turn lights a small light or some other visual signal on the switch-board and shows the operator that somebody is calling on the line. This method of signals would not do for the other end, as the subscriber would seldom be where he could see the light; a bell can be heard if he is in hearing distance.

In the magneto system an alternating current is generated by a machine turned by a crank at the side of the box. This current flowes first in one direction and then in the opposite direction, alternating 1000 times per minute. This passes over the line and rings a bell, polarized by a permanet magnet, the positive part of the current attracting the armature to one pole of the magnet and the negative current to the other pole. In this way a continuous oscillation of the bell clapper occurs, the frequency corresponding to the frequency of the ringing current.

It will thus be seen that the most complicated part of the telephone is the signalling part, which is entirely cut out when the connection is going on.

Sunlight and Color.

All color comes from light. In the dark things are all one color, and the fixing of colors and tints in nature depends largely upon exposure to the sun. The dwellers in sunless caves, prisons and dark parlors become colorless. Fruits on the sunny side of trees excel in beauty as well as in flavor; the dingy and colorless specimens grow in the shade. It is said that the same principle holds good in the fixing dyers' colors. Some one told a story that years ago an English manufacturer of carmine, who was aware of the superiority of the French color, went to Lyons for the purpose of learning how to improve his process of manufacture. He bargained with the most celebrated manufacturer in that city for the acquisition of his secret. After paying a large sum of money he was shown all the process, and saw a most beautiful color produced, but he found not the least difference in the French and his own method of fabrication. He minutely examined the water and the materials, which were in every respect similar to his own, and then, very much surprised, said:

"I have lost both my labor and money, for the air of England does not permit us to make good carmine." "Stay!" said the Frenchman, "don't deceive yourself; what kind of a day is this?" "A bright, sunny day," replied the Englishman. "Yes, and such are the days," said the Frenchman, on which I make my color. Were I to attempt to manufacture it on a dark and cloudy day my results would be the same as yours."

This will apply to the making of many other colors used in manufactures, and also in the fine arts, for it illustrates in a practical way the chemical influence of sunlight upon certain coloring compounds or mixtures.

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Next comes the Supreme Council Convention at Reading, Pa. May 12th, 13th and 14th don't fail to be there, this means you. Every reader of the practical engineer is hereby invited.

The Grand Council Convention at Allentown was the most successful one ever held. The arrangements were excellent and much credit is due Lehigh Council.

The popularity of Past Grand Chief Driesbach was amply attested during the Allentown Convention. His administration has been well conducted throughout and he richly deserved the many nice things that were said about him.

Don't be afraid of over-crowding: Reading is a noted convention city. They are accustomed to crowds and can take care of half a dozen conventions at once.

Few of the Allentown delegates enjoyed the trip more than did the delegation from Philadelphia Council No. 7 brothers Kelley Muncy and Eccles.

Delegate Aaron Buch from Sunbury made a good impression on the boys at Allentown and we shall hope to see him at future conventions.

Columbia Council was ably represented by, Courtney and Nolte good fellows both of them.

Fred Markoe of Municipal Council P. F. D. was unusually popular for a new delegate at Allentown. He took an active part from the first and his sound logic caught the convention at once. They appreciated him too, and showed their appreciation by electing him to an important office.

Those who are fond of mountain climbing will have an opportunity to practice while attending the Supreme Convention at Reading. Don't forget the date, May 12th.

Massachusetts should send a good delegation to Reading this year, especially from the eastern end of the state.

Evangeline Council of new Iberia La, has taken in a number of new members of late, and report excellent prospects for the future. They will send a delegate to the Reading convention.

Enterprise Council No 1 of Nashville Penn. is reported to be booming. They will doubtless send one or more delegates to the convention.

Baltimore will send a car load to the Reading convention all good ones too.

John E. Sweet Council is prospering and we understand, will be well represented at Reading.

Deputy Supreme Chief of Oregon B. F. Myrick is coming east but he may not reach here in time for the convention.

Prize Drawing.

A prize drawing contest was held by Lehigh Council, of Allentown, Pa., on Wednesday evening, March 19, following the convention. The first prize, which consisted of a set of Hawkins' Works, six volumes, was won by S. M. Ruch. The second prize went to Alvis Smith, and the third to A. M. Plummer, of Atlantic City. The drawing was conducted by Grand Chief Front and Delegate Frank S. Miller, of Reading.

You are Welcome Every Friday.

The trance has ended, the purring kitten has become a roaring lion, and stands ready to do battle for the supremacy. Welcome Council No. 12, of Philadelphia,, which has long been a reputation for extreme conservatism has been aroused by the worthy and successful methods of other local councils into a state of action which promises to produce good results and a little excitement besides.

The program is briefly as follows: Every Friday evening until further notice the council will hold a short business session, not to exceed half an hour, after which the meeting will be turned over to a committee whose duty is to instruct and entertain the members and visiting friends. An eminent instructor has been engaged to lecture on subjects of special interest to engineers. A substantial luncheon will be served after each meeting, and pipes, tobacco and matches will be plentiful. A full orchestra will be in attendance. A feature of the plan is that no resolutions can be offered nor any tickets offered for sale.

The council meets at 1712 North 12th Street every Friday evening. All engineers are cordially invited to attend.

In Cold Storage 2,000 Years.

Dr. Herz, of St. Petersburg, Russia, has discovered in Siberia a huge mammoth in an almost perfect state of preservation, the body having been frozen in the ice for 2,000 years. The animal was covered with a coat of rather thick brown hair. There was grass in its mouth and food in its stomach.

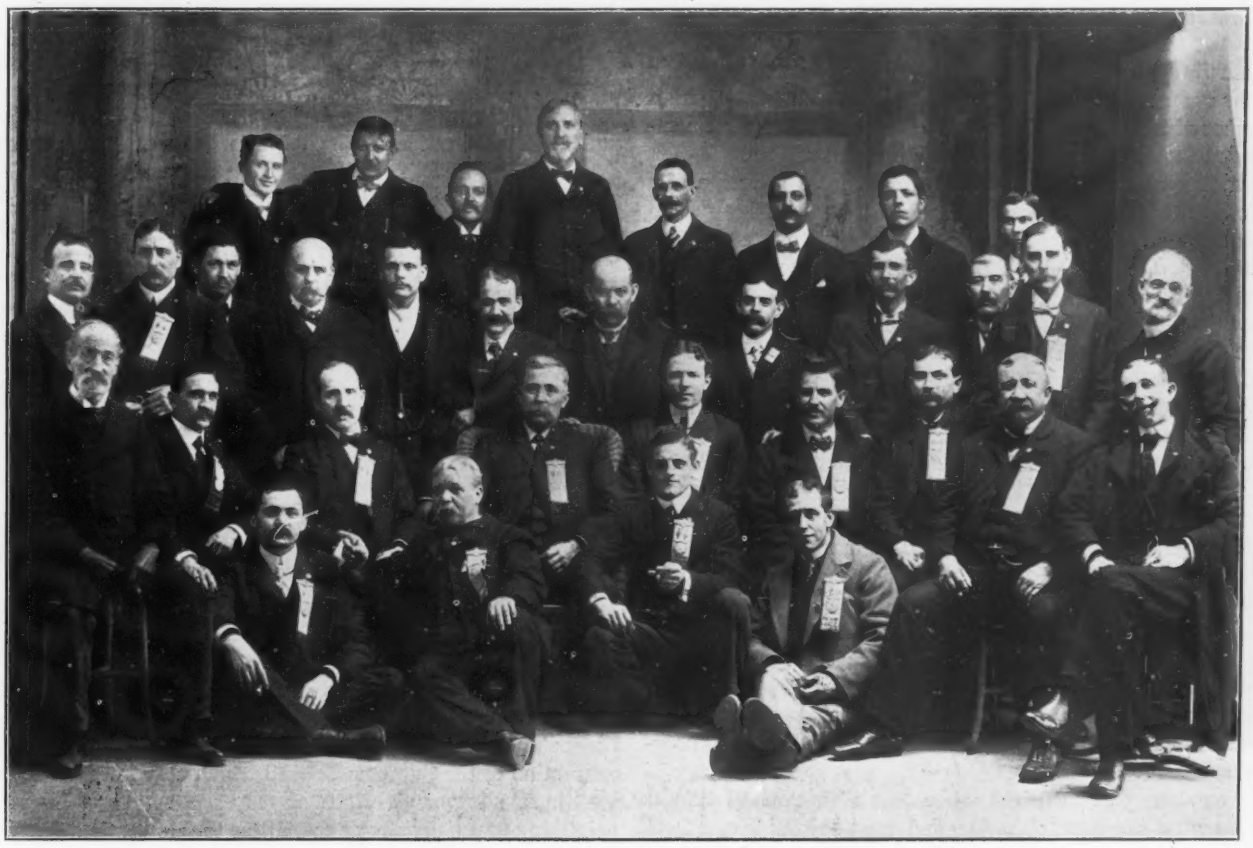
Pennsylvania's Grand Council Convention. American Order of Steam Engineers.

The 14th annual convention of the Grand Council of Pennsylvania, American Order of Steam Engineers, was held at Allentown, Pa., Tuesday and Wednesday, March 18 and 19. The convention was not only the largest in point of attendance ever held, but was a pleasant and successful affair throughout; great credit is due the members of Lehigh Council for the most excellent manner in which they entertained the visitors. Everything possible was done for the comfort and pleasure of the delegates and visiting friends, and in this, as in every other particular, the committee of arrangements were highly successful, for all agreed that they had never spent a more enjoyable time; the only regret being that it was too soon over. Each individual member of Lehigh Council has good reason to congratulate himself upon his good fortune in being a member of a council composed of such an excellent lot of good fellows.

The delegates commenced to arrive Monday evening, and when the gavel fell Tuesday morning at the opening session, all were present to respond to their names. The convention was called to order by Grand Chief A. P. Driesbach in a few well chosen words; the Grand Chief introduced Mayor James L. Schaadt, who, in a brief but exceptionally appropriate address welcomed the delegates to the city. Mayor Schaadt is a lawyer of marked ability and in his time has had several cases in which boiler explosions and accidents caused by machinery figured largely, all of which especially fitted him to address an assemblage of engineers.

He told the boys to enjoy themselves to their indicated capacity while in the city, but warned them that while there was no scarcity of fuel, he hoped they would regulate the "draft" so as not to exceed normal pressure. He said if their valves were properly adjusted there would be no danger of a runaway, for most people who came to Allentown wanted to stay as long as they could.

In concluding the mayor paid high tribute to the A. O. S. E., the principles, and objects of which he appeared to understand thoroughly. He spoke of the educational feature of the order in terms of high appreciation, and of the "no strike" clause as a mark of unusual common sense. The mayor was warmly applauded as he retired from the hall.



A Group of Delegates at the Allentown Convention

The morning session was devoted entirely to routine business until 1 P. M., when a recess was taken for dinner; after dinner a number of the delegates and officers had their photographs taken which are reproduced herewith.

The afternoon session was uneventful and at 6 o'clock a recess was declared until Wednesday morning.

THE BANQUET.

What turned ont to be the pleasantest feature of the occasion was an elegant banquet given in honor of the officers and delegates by Lehigh Council on Tuesday evening in the spacious dining rooms of the Grand Central Hotel, and which mine host Strauss afterward declared to be one of the finest banquets that he had ever served.

There were 160 persons present, including several very charming ladies. The banquet room presented a handsome

appearance. The tables were richly decorated with beautiful tropical plants and bouquets; neat little menu cards were distributed as souvenirs. The menu was choice and the service excellent. The Allentown Philharmonic Orchestra rendered a most enjoyable program during the course of the banquet.

Secretary A. J. Strauss, of Lehigh Council, ably officiated as toastmaster and called upon the following, who responded with addresses: Hon. Hugh S. Crilly, Hon. Joseph W. Mayne, member of the State Legislature, Ex-Congressman H. W. Sowden, J. J. Snyder, Grand Recording Engineer, Al Keppleman, Mayor Jas. L. Schaadt, L. L. Rice, and Grand Chief A. P. Driesbach.

We regret exceedingly that lack of space prevents us from publishing some of these addresses, as they were decidedly the best that we have ever heard upon occasions of this kind, and unusually appropriate; each of the speakers bringing out many points of special interest to engineers. Mr. Crilly had been a member of labor unions for many years, but he warmly commended the A. O. S. E. for declaring against strikes.

Mr. Mayne, who is on record as a staunch advocate of a state license law for engineers, declared that the order go into politics to the extent of making an organized effort to defeat office holders who violated promises, or declined to support honest measures presented by organized workmen. He urged those present to fight on, and predicted that the time was close at hand when Pennsylvania would be blessed with an engineer's license law. He was warmly applauded.

Mr. Sowden dwelt upon the declaration "that the order shall not be used for religious purposes." He reviewed the objects of the order in detail, and declared that the work which the order was doing made it a religion in itself than which there was none better. He paid repeated compliments to the ladies in return for which he received their warm applause.

Mayor Schaadt stated that if he were an engineer, he should love his engine as his wife. He then proceeded to draw comparisons between the wife and the engine with the result that he soon had his hearers convulsed with laughter.

Mr. Keppleman, in a humorous speech presented a huge pretzel to Lehigh Council with the compliments of Enterprize Council, of Reading, the pretzel being one of Readings numerous emblems.

It was long past midnight when the affair came to a close. It was voted the most elaborate and most enjoyable ever held by the State Council. The visitors especially enjoyed the helpful speeches made, in which the dignity, responsibility and nobility of their work and the principles of their organization were extolled eloquently and forcefully.

WEDNESDAY'S SESSION.

Despite the good time Tuesday evening the delegates were all on hand in time to answer roll call Wednesday morning. It was 2 o'clock P. M. before the business was all disposed of, and the convention finally adjourned. The session was interesting throughout, including, as it did, the election of new officers, and a lengthy discussion of a proposition to discontinue meetings of the Grand Council, thus giving all subordinate councils of the state direct representation in the Supreme Council, the same as in states where no Grand Councils are maintained. As it is, the subordinate councils of Pennsylvania have no direct voice in the Supreme Council except through the limited number of delegates elected from the Grand Council. After considerable discussion and careful consideration, the proposition was favored by an almost unanimous vote, only four delegates opposing it. The Grand Chief then appointed a committee of five with full power to arrange the numerous details in connection with the movement. If the new arrangement becomes operative it will materially reduce the percaptia tax in this state.

ELECTION OF OFFICERS.

The election of officers resulted as follows: Grand Past Chief Engineer, A. P. Driesbach, Allentown; Grand Chief Engineer, Hiram Trout, Reading; Grand First Assistant Engineer, John J. Kelly, Philadelphia; Grand Senior Master Mechanic, W. J. Courtney, Columbia; Grand Junior Master Mechanic, Thos. Marshall, Philadelphia; Grand Recording Engineer, A. L. Keppleman, Reading; Grand Corresponding Engineer, Fred Markoe, Philadelphia; Grand Financial Engineer, W. J. Gifford, Philadelphia; Grand Treasurer, Wm. J. Beatty, Manayunk; Grand Inside Sentinel, J. J. Nolte, Columbia; Grand Outside Sentinel, Aaron Buck, Sunbury; Grand Trustee, Edward Riker, Philadelphia; Representatives to Supreme Council at Reading, May 11-15: A. P. Dreisbach, Allentown; G. W. Kennedy, W. J. Eccles, J. L. High, L. J. Colloway, Philadelphia; W. J. Beatty, Manayunk.

Following the installation of officers the convention adjourned. After dinner at the hotel a number of the delegates accepted an invitation from Chief Engineer H. T. Raisbeck to visit the great Atlas Cement works at Northampton. The immense plant was viewed with much interest, after which all returned to headquarters at the Grand Central Hotel and preferred to leave for home, all vowing to meet again at Reading on May 12, next.

The Reading Convention. American Order of Steam Engineers.

The number "13" may be a hoodoo, but the members of Progress Council American Order of Steam Engineers, at Reading, Pa., bearing that number, believe it to be lucky, for with that number they have prospered beyond their early anticipations. In any case they do not intend to permit any hoodoo's to interfere with the success of the sixteenth annual convention of the Supreme Council which they have invited to meet in Reading on the 12th of may next. They have appointed an unusually strong committee to arrange the necessary details of the convention and to prepare for the comfort and enjoyment of the visitors while there. The names of the members of this committee are to those who know them sufficient assurance that the arrangements will be perfect. They are as follows: Hiram Trout, Chairman; Al. Kepplemen, Secretary; A. B. Hess, James M. Fisher, Jno. H. Seibert.

The committee has already arranged for almost every available moment of the delegates time and there is much yet to be done. There is so much to see in and about Reading that all who go there may expect to be kept on the move.

A special feature of this convention will be an exhibition of steam specialties and engineer's supplies, which the committee are preparing for. The exhibits will be placed around the sides of the large hall in which the convention is held. The light and other conditions are good so that it will be a comparatively easy matter to arrange an attractive exhibit. Moreover, Reading is noted for its great variety of manufactures, and this will afford an excellent opportunity for demonstrating

the value of special appliances to the local engineer and steam users.

For information concerning space or other details address Executive Board A. O. S. E., Board of Trade Rooms, Reading, Pa.

The Grand Chief Engineer of Pennsylvania, American Order of Steam Engineers.

Hiram Trout, the new Grand Chief Engineer of Pennsylvania, American Order of Steam Engineers, was born at Sinking Springs, Pa., in 1850, his parents removing to Reading two years later. He was educated in the public schools of that city, and has resided there continuously ever since. In 1872 he first saw service in a boiler-room, as assistant fireman, in

HIRAM TROUT
Grand Chief Engineer, Pennsylvania A. O. S. E.

the Reading Cotton Mills, where he remained for fifteen years, gradually rising to the position of engineer. In 1887 he accepted a position as chief engineer of Grimshaw Brothers' large silk mill, which position he held for four years, resigning to accept the position of chief engineer at the outer station of the P. & R. Electric Light plant. He remained there for sixteen months, and then returned to his old position at the silk mill. This was ten years ago, and you can still find him there, fat and jolly and looking ten years younger than he is.

He is a charter member of Progress Council, No. 13, A. O. S. E., and has always been an ardent advocate of a State license law for engineers. As Grand Chief Engineer, he will do every thing in his power to secure the passage of such a law during his term of office.

Mr. Trout has been an honored citizen of the city of Reading; when but twenty-six years old he was elected a member of City Councils, at the expiration of which he was elected for a term of four years as School Controller. In 1898 he was again elected to the same office for a period of four years, which just expired in February last.

He is chairman of the Committee of Arrangements for entertaining the delegates and visitors to the next Supreme Council Convention, which will be held in Reading, May 12th, 13th and 14th next, and is leaving no stone unturned to insure its success.

Educational Committee, A. O. S. E.

JOHN MARTIN, Secretary, 2655 East Clearfield St., Phila.

The following questions are intended to create discussion in councils of the American Order of Steam Engineers. Answers will not be required by the Committee but prizes will be awarded by the Committee for the best essays prepared by individual members upon any of the questions asked. The PRACTICAL ENGINEER will give cash prizes for the best essays prepared by engineers whether members of the A. O. S. E. or not.

1. What is the total units of heat in the feed-water at 212 degrees temperature, boiling point, under atmospheric pressure?

2. What percentage in units of heat is gained in the feed-water heater, the initial temperature being 40 degrees, and on leaving the heater 212 degrees. Boiler pressure 70 lbs. And what percentage of gain at 218 degrees?

3. At what temperature does the water boil in your boiler under 90 lbs. pressure per gauge; and what is the total heat units in each pound of water in the boiler at the above-named pressure?

4. What is the total heat units of the water in a locomotive boiler under 200 lbs. pressure per gauge (in each and every pound)?

5. What will be the total heat units in a pound of water boiling in an absolute vacuum, and what would be the temperature?

6. What is the total heat in 1 lb. of ice at 32 degrees temperature?

7. The initial temperature of the feed-water is 85° F. and the final temperature 180°. Find the per cent. gained if gauge pressure is 60 lbs.?

8. The initial temperature of the feed-water is 60° F. and the final temperature 250°. Find the per cent. gained if gauge pressure is 90 lbs.?

9. A boiler evaporated 3,500 lbs. of feed-water per hour from a temperature of 180° into steam at 85 lbs. gauge pressure. What was the horse-power developed?

JOHN MARTIN, Secretary.

BOOKS AND PUBLICATIONS.

The popular author, W. H. Wakeman, 64 Henry street, New Haven, Conn., has just issued the second edition of his latest book "Engineering Practice and Theory." It has been but a few months since the first edition was presented, and the fact of a second edition being necessary seems to indicate that the book possesses merit.

In this work the author gives in his most graphic form those points relating to the intelligent and successful operation of a steam plant, which every engineer must know in order to succeed in his chosen profession.

It is written not only to instruct but to hold the attention and interest of the reader from the beginning to the final paragraph. The explanations are clear and concise; the questions are asked and answered in a manner to become lucid to the reader at once.

The final pages contain a feature which will at once commend it to the student; this is a list of questions relating to the contents of the book for the purpose of testing the reader's comprehension of its teachings.

It is sold at the popular price of one dollar. Address the author as given above.

LETTERS FROM ENGINEERS

In order to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories and general engine room experiences are especially solicited.

Kind Words from Supreme Treasurer of the A. O. S. E.

Editor THE PRACTICAL ENGINEER:

I congratulate you on the improved appearance of THE PRACTICAL ENGINEER. The new title design on the front cover is artistic and attractive. All the cuts are very clear and distinct, which shows that you are a lover of good workmanship. The article by Mr. Strohm and "Old Friends in New Clothes," by Brother Rhodes are very interesting, while the "Letters From Engineers" contain practical suggestions of rare value.

I was pleased to see in your March issue an essay on artificial refrigeration by Brother Sherman, and I hope that more of our brother engineers will take up questions of the Educational Committee, and write essays on them. The Educational Committee was created for the purpose of asking questions with a view to encouraging discussion in the council meeting; but the writing of interesting essays show that the work is receiving intelligent discussion and is appreciated; thereby repaying the committee for their efforts.

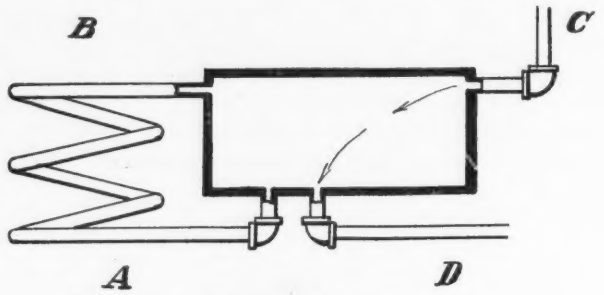
I am a reader of many periodicals, but I consider THE PRACTICAL ENGINEER the best paper in the world for the price. Every operating engineer, either a member of the American Order or not, should read it regularly. The knowledge of their profession which they would obtain from it would, in the course of a year, repay them many times the cost of their subscription.

GEO. W. RICHARDSON,
Supreme Treasurer A. O. S. E.

Versus "Slack" Economizer.

In the PRACTICAL ENGINEER for March Mr. Harry Slack asks me if I don't think the economizer shown by him does not eclipse that shown by me the month preceding. Kindly permit me to tell him no I don't, and give him my reasons for so saying.

I will assume, first, that he places his pump at D, which is between the heater coil and the boiler. In my device the heater coil was between the pump and boiler. In one case, the pump has to handle hot water; and in the other case, cold water. Again, with the pump at D, the cold water enters at C, and must have a pressure greater than that which may at any time be in the heater coil A, B. It is doubtful if this is a safe and sure plan for getting water into the boiler. But, perhaps, he places his pump at C, instead of D. What would then take place? It is an old-established law that water will flow through the path of least resistance. If the tank and heater coil are full of water when fires are started (they certainly should be), and as the heat passes over the coil A, B and the water in it becomes hot and begins to circulate, Mr. Slack evidently believes that this hot water will circulate all through



Slack Economiser.

the tank. But will it? It seems to me that cold water entering at C, would want to flow in the direction of the arrows (through the path of least resistance) to D, and not enter the heater coil, as Mr. Slack evidently believes it would. There would be a small amount of circulation caused by the heat acting upon the water in the coil. But the heat imparted to the water entering the pipe D, is such a small quantity that I believe the Slack economizer would be better if C, was connected to A, and B to D, which would dispense with the tank which defeats the ends for which this rig was designed and which makes it like that shown by A READER.

How Dan Rice Got His Electrical Knowledge.

(Letter No. 2.)

Dan subscribed for an electrical journal, and when it came he found an article which said, that only 5 per cent. of the energy supplied to an incandescent lamp is used as light, the other 95 per cent. disappearing as heat, and a little further down the column he found that an arc light turns 15 per cent. of the power supplied into light. Just then the superintendent came in and told Dan that the firm wanted the warehouse wired and lamped, as it would lower their insurance.

Dan told him that the dynamo had load enough now, but he said he would see what he could do for them. He had ordered a closed arc to hang out in front of the office, so when the lamp came he decided to experiment a little with it. He found that the arc would give about as much light as twenty incandescents, and would save five amperes. A little calculation showed him that if he put in about six arc lights, that he could furnish the extra lights all right. So the warehouse was wired and the lights ordered. In due time they came, and were put in place. They were said to burn from 100 to 150 hours without trimming. He was greatly surprised when they went out, after burning about thirty hours; upon investigation, he found that the lower carbon was burned and part of its holder, the upper one was hardly burned at all.

He trimmed the lamps as before, but remained to watch them burn. He noticed that the lower carbon burned cup-shaped, while the upper one was pointed. He saw that the lower carbon was also the brightest, and on account of the cup-shape, most of the light reflected upward; and he knew that

that was not right, and that it ought to be the other way 'round. The upper carbon being the brightest and concave, the lower not so bright and pointed carbon. Then he remembered hearing the foreman of an electric light plant tell the trimmers to be careful not to get his lamps upside down; and he wondered if he had his lamps connected right, and looked through his paper to see if he could find anything to help him out.

He found the question, "Why does the upper carbon burn out faster than the lower one?" The answer was, "Because the current in leaving the upper carbon carries some of the carbon with it, and deposits it on the lower one." The current is also stronger in the upper carbon. The resistance of the air cuts it down some, so that the lower carbon is never as bright unless the lamps are connected wrong. So by that Dan found that he had his lamps connected wrong, and must reverse the wires. The arc lights cut down the load so that the wareroom was lighted all right, only the lights were a little dim.

At this juncture an electrician came along and said: "Dan, why don't you put in a booster?" Dan had to ask what a booster was, and he was told that it was a motor generator—one machine with two commutators and two windings on the armature. "Suppose you get a small one, Dan; it will take the current one side at 110 volts, and deliver current on the other side at 117 volts. You will lose seven volts on the line, giving you 110 at the wareroom and your lights will burn all right."

While unpacking some new incandescent lamps next day, he found one marked 104 volts. He tried it in the socket and found that it burned all right. He took it over to the wareroom and it burned nearly up to candle power. The thought then occurred to him that if he could get some 103 volts lamps, they would be all right. He wrote to the lamp people, and they told him that they could furnish them; so he bought a few dozen and kept them in the wareroom.

In the course of a few weeks the firm decided to put a machine in the basement to do their extra shop work. Dan called in the officers and consulted as to the best way of driving the machinery.

As the engine had load enough and the basement was quite a distance from the engine, a line shaft could not well be run to it, so it was decided that they should get a motor. As Dan went back to the engine room he said to himself that he must find out about the workings of the motor, or he would be stuck. His little book told him that a motor was built just the same as a dynamo, and if you drive it by mechanical means, it is a dynamo; and if you supply it with an electric current, it is a motor. So far, all right; but the explanation was too short to satisfy Dan. He makes another visit to the engineer at the light plant, to whom he told his trouble.

He was told that a shunt-wound motor would be the best, as it would run at nearly constant speed with all loads. "Well, now, I would like to ask you three questions," said Dan. "What makes a motor go?" "The theory is, that the current flowing through the armature coils magnetizes the core, thus producing poles which are attracted by the field poles which pull the armature around. The commutator performs the same duty in each case, that is, keeps the current flowing in the coils that will produce the best effect." No. 2. "Why is a starting box required?" "Because," said the engineer, "the resistance of the armature is very small; and if you turned all the current on at once, it would act the same as a short circuit on the line and blow the fuse, and perhaps burn out an armature coil. "That book of yours," continued the engineer, "says that if you run a motor by mechanical means, it will generate a current. Now, when the motor is running it must be generating a current, just the same as if you were driving it. This current can not be as strong as the current that drives the motor, and being generated in the opposite direction from the driving current, it acts as a sort of resistance and keeps the amount of driving current flowing through the coils fast enough to do the work. This counter, E. M. F., as it is called, keeps a shunt-wound motor at constant speed. If the load is thrown, the motor speeds up a little and generates a higher counter, E. M. F. This keeps the speed from going any higher. The opposite happens when the load is thrown on. Now, what is your third question, Dan?"

"This is it: How can you reverse a motor?" "Oh, that is easy; just reverse either the armature or the field leads. The armature leads are generally the easier to change. You can reduce the speed also by putting a resistance in the armature leads. It should be made of large wire so that it will not heat, but it is best to avoid all resistance possible, as it is a waste of power. The heat that you feel rising from the Rheostat has all to be paid for."

"Come again, Dan," said the engineer. As Dan walked home that night he thought what a different sort of a fellow he was from what he used to be when he first took charge of the engine room. He was ashamed to ask his associates to explain anything to him, as he did not want to appear ignorant; but now he had gotten bravely over that. His electrical experience was sufficient to prove that willingness to learn is a great help to a person when he is in trouble.

J. W. E., Oswego, Kansas.

The Steam Boiler Injector.

This appliance, which was invented by Giffard, is in many respects the most peculiar and interesting apparatus connected with the steam plant. It is an instrument which converts the energy of the steam into mechanical work without the aid of any moving mechanism whatever. Before describing it, it is necessary for us to notice the difference between the velocity of steam escaping from a boiler, and water issuing from the same boiler and under the same pressure of steam. It is impossible to compute this accurately within reasonable limits, on account of the theory and the rules by which it is determined, but it is safe to say that for the pressure usual to land stationary boilers, the velocity of steam is from fifteen to twenty times, that of water issuing from the same boiler.

Next we will consider the steam discharge. Suppose that some of the steam was discharged from a boiler through a pipe at the usual high velocity it attains, and that while in the act of discharge, it was suddenly condensed by passing through an intensely cold medium. It is plain that the resulting water condensed from the steam would travel forward with the same velocity which it had already acquired when in the state of steam and if the noxious particles of water could by any means be gathered together into a continuous stream they would be more than able to overcome and force back into the boiler any opposing stream of water of the same size directed against them from the water space or room of the boiler. Now, we see that the velocity of the condensed steam is so great that

it possesses not only enough energy to re-enter the boiler in the face of an opposing stream of water of its own size, but it can also impart energy to a much larger mass of water, so that this larger mass can also enter the boiler.

In fact, the injector is simply an instrument for allowing steam to rush from a boiler and suck up and mix for itself a stream of cold water, by which it is condensed, and to which it imparts so much of its own velocity that the combined mass of cold water and condensed steam together enters and feeds or supplies the boiler.

Fig. 1 shows an elementary form of such an injector suitable to demonstrate the principle on which the injector works.

A, is the boiler, B, is a pipe leading from the steam space and terminating in a nozzle, C, is the cold water feed pipe to the injector, leading from the tank and terminating in a hollow cone surrounding the steam nozzle. When the steam is turned on and escapes from the lower edge of the hollow cone it creates a partial vacuum in the cone and pipe C; the water then rushes up the pipe C, and into the cone surrounding the nozzle, (the termination of B) where it meets with the escaping steam issuing from nozzle B, which it at once condenses. The

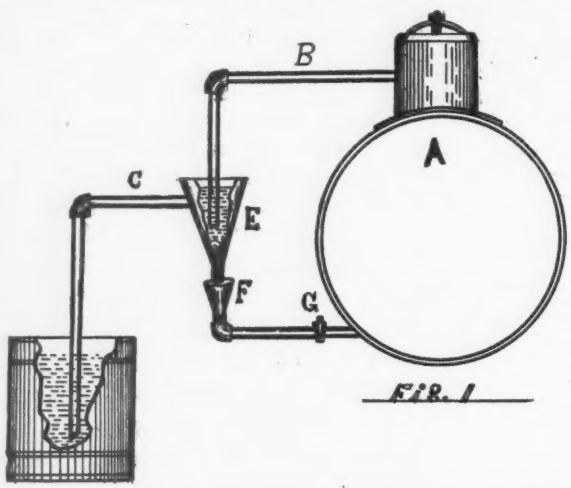


Fig. 1

particles of condensed steam mingling with the water surrounding them, communicate their motion to the latter, and the whole combined mass is delivered with a higher velocity into the feed pipe F, raising the check valve G, and into the boiler.

This gives the principle on which an injector works, and such an injector, if properly proportioned, would work very well for a fixed pressure of steam in the boiler; and for a fixed temperature of the feed water. But in practice these quantities vary and injectors must be made to suit all such contingencies; for instance, if the pressure of the steam increases, the area in the opening of the steam nozzle, (at the termination B), must be increased, and when the pressure falls it must be made smaller.

There are three distinct types of live steam injectors, the "simple fixed nozzle," the "adjustable nozzle," and the "double." The first mentioned has one steam and one water nozzle which are fixed in position, but one proportional so as to yield a good result within a certain range of steam pressure. There is a steam pressure for every instrument of this type at which it will give a maximum delivery, greater than the maximum delivery for any other pressure either higher or lower within its range.

The second type has but one set of nozzles, but they can be so adjusted relatively, as to produce the best results, throughout a long range of action, that is, it so adjusts itself that its maximum delivery continually increases with the increase of the steam pressure. This second type is more preferable than the fixed nozzle, because it has, as stated, such a long range of action.

The "double" injector has two sets of nozzles, the "lifter" and the "forcer," the "lifter" draws or raises the water from the water supply and delivers it to the "forcer," which sends it on into the boiler. All double injectors have fixed nozzles, and all injectors of any type are similar in operation. They are designed to bring a jet of live steam from the boiler in contact with a jet of water so as to cause it to flow continuously in the direction followed by the steam, the velocity of which, in part, assumes back into the boiler and against its own pressure.

As a thermo-dynamical machine, the injector is fairly perfect, since all the heat received by it is returned to the boiler, except, of course, the small part that may be lost by radiation, consequently its thermal efficiency should be in most every case nearly 100 per cent. On the other hand, because of the fact that its heat energy is principally used in the warming up the cold water as it enters the injector. Its mechanical efficiency, or in other words, the work done in lifting water, compared with the heat expended, is very low.

Summing it all up, the action of an injector is as follows: Steam being turned on, it rushes with great velocity through the steam nozzle into and through the combining tube, and by this action induces a flow of air from the suction pipe which is connected to the combining tube, creating more or less a perfect vacuum, sucking up, or inducing a flow of water. Then, after the water commences to flow into the injector, it receives motion from the jet of steam and absorbs heat from the steam and finally condenses it. It then moves on into the forcer tube simply as a stream of water, at a low velocity compared with that of the steam. At the beginning of the forcer tubes it is subjected only to atmospheric pressure, but from this point the pressure increases and the water moves forward at a diminished velocity into the boiler.

There is also a form of injector called the "exhaust" injector, so named because it uses the exhaust steam from a non-condensing engine. The exhaust from such an engine has fourteen and seven-tenths (14.7) pounds of work, and the steam entering the injector is condensed and the water forced into the boiler upon the same general principle as the "live steam injector." Probably the exhaust steam injector would be more generally used were it not for the practical objection which has arisen—in that it carries on into the boiler the waste oil from the steam cylinder. J. T. M., Pratville, Ala.

Built 20,000 Locomotives.

On February 27th the Baldwin Locomotive Works, Philadelphia, completed its 20,000th locomotive and celebrated the event and its seventieth year of existence. Matthias Baldwin, founder of the works, built his first engine in 1832, doing most of the work himself, and with scarcely any tools to work with. "Old Ironsides" was the name of this pioneer. It weighed only five tons was mounted on four wheels. These wheels had cast iron hubs, wooden spokes and rims, and wrought iron tires. This locomotive cost $3,500, and attained a speed of 30 miles an hour. The Baldwin works to-day cover 16 acres, employ 11,000 men and turn out five locomotives every day.

QUESTIONS AND ANSWERS.

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers with questions, he especially desires the readers in such cases to contribute any further information in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communications.

Editor PRACTICAL ENGINEER:—Will you kindly tell me the most convenient way of obtaining the required size of safety valve for any boiler? A. R. C.

Rankin's rule for obtaining the dimensions of safety valves is: Multiply the number of pounds of water evaporated per hour by .005, and the product will be the area in square inches of the valve. The United States steamboat inspection law requires for the common lever valve one square inch of area of valve for every two square feet of area of grate surface. A rule adopted by the Philadelphia Department of Steam Engine and Boiler Inspection is: 1. Multiply the area of grate in square feet by the number 22.5. 2. Add the number 8.62 to the pressure allowed per square inch. Divide one by two, and the quotient will be the area of the valve in square inches.—EDITOR.

Editor PRACTICAL ENGINEER:—Frequently in the study of catalogues, etc., I find in articles referring to heat or combustion of fuel the letters B. T. U. and U. E. I would be gratified if you would inform me just what is their significance.

ALBERT HAYES.

The letters B. T. U., or British Thermal Unit, is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at and near its temperature of greatest density, 39°F. The Unit of Evaporation (U. E.) is the quantity of heat required to convert one pound of water at 212°F. into steam of the same temperature, and is equivalent to 965.7° B. T. U.

Editor PRACTICAL ENGINEER:—Will you please tell me through your columns just what is the relation between a watt and a horse-power?

A horse-power is equivalent to 33,000 foot pounds per minute, or 550 per second. It is the force required to raise a weight of 550 lbs. one foot vertically in a second. The watt is the product of the voltage into the current of a dynamo, and is the unit of electrical power measurement. It is equivalent to .735 pounds per second. On account of its being so small, the kilowatt is more generally used. Thus a thousand watts, or 735 foot pounds per second, or 1.2 horse-power in the same time. So, if it is required to find the mechanical horse-power generated by a dynamo yielding 600 amperes at 110 volts, we proved as follows: 600x110=660,000 watts, or 66 kilowatts.

Now, since a kilowatt is 1.2 horse-power, 66 kilowatts are 66x1.2=79.2 horse-power. If it be desired to convert horse-power into watts, reduce the horse-power to foot pounds per second and divide by .735.—EDITOR.

Editor THE PRACTICAL ENGINEER:—I would like to ask Mr. Harry W. Sherman whether he ever ran a refrigerating plant or system where brass and copper came into direct contact with the ammonia. Mr. Sherman says that anhydrous ammonia has no effect on these metals, but I have found that it corrodes them very rapidly, though not affecting iron or steel.

P. T. L., Philadelphia. Pa.

Editor PRACTICAL ENGINEER:—Will you please publish in your columns the usual formula for making a brine suitable for refrigerating or ice-making plants?

A. BOUTILIER, Texas.

A brine for the above purpose can be made with from 3 to 5 pounds of chloride of calcium, or muriate of lime, in accordance with its degree of purity, dissolved in each gallon of water. The density of this solution is about 23° Beaume, its weight about 13½ pounds per gallon, and the freezing point is 9° Fahr. As the above standard of density must be kept up, in order to prevent the brine from becoming congealed in the refrigerator, or the ice-making tanks or boxes, it is desirable to test it periodically with a salinometer.

In the best American practice, first quality medium ground salt, preferably in bags for convenience of handling, is employed, the proportions being about 3 pounds of salt to each gallon of water. The brine is made in a brine mixer, consisting of a water-tight box or tank about 4 ft. x 8 ft. x 2 ft., having a suitably perforated false bottom, and a small compartment, partitioned off at one extremity, communicating with the main compartment through an overflow situated at the upper end of the said partition, and fitted with a large strainer to prevent the passage into the said compartment of salt of foreign bodies. The water is admitted through a perforated pipe situated beneath and running the full length of the false bottom, and the brine is removed through a pipe from the upper part of the end compartment, at the lower extremity of which latter pipe is a strainer box and strainer, through which the brine passes before delivery into the brine tank. A salt gauge, salinometer or hydrometer is also placed in the said end compartment.

The salt should be dissolved in the water until it reaches a density of about 90° by the hydrometer. To facilitate dissolution it is desirable to stir the salt in the mixer with some handy implement, the said salt being shoveled in as fast as it can be got to dissolve.

By the use of this mixer the settlement of salt on the bottom and on the coils in the brine tank, which inevitably results when the dissolution is effected directly in the latter, is avoided.

To maintain the strength of the brine, it is recommended to suspend bags filled with salt in the brine tank, or to pass the return brine through the above-described brine maker or mixer.

Editor THE PRACTICAL ENGINEER:

I am working hard to gain a foothold in my chosen profession, that of stationary engineering. I have taken a course in a leading correspondence school, and am still burning midnight oil. But the question I want to ask is: Do you think me too young to be trusted with a small steam plant? As I love the profession and would like to be put upon the stage of action. I will be eighteen years old next April.

ELLIS STARR.

[You are rather young to take charge of a plant; we would advise you to seek a position as assistant, oiler, or, if you are of robust build, at firing. The experience thus gained will be invaluable to you.

Items of Interest.

Recent official calculations estimate that the total power of the large waterfalls in Lapland, which are suitable for generating electricity, reaches a total of 10,000,000 horse power, the average head being taken as 1,213 feet (370 meters). One company is already engaged upon a generating station in the vicinity of one of the large falls, and will use the power to work the poorer quality of iron ore in its mines.

The First Steam Gauge.

In these days a steam boiler without its gauge would indeed be a curiosity. Yet there was a time when the first device for recording steam pressure caused great interest, and the *Mechanical World*, London, gives an illustration of the first gauge, which is most carefully preserved as a most interesting relic. The diameter of the face is 6½ inches, the depth of the case is 6¾ inches, distance from the top of the case to the bottom of the flange 9½ inches. With the exception of the flange the rest of the case was made in thick wrought brass. The dial is silver plated. The total length of the instrument, including the ½-inch iron syphon, is 23 inches.

It is widely known that this first steam gauge was fixed up and personally superintended in accordance with instructions received from George Stephenson, by the inventor himself—the late Sydney Smith—over fifty years ago.

The following memorandum has been found of the initial test:

"Early in the morning following the erection of the gauge, the two nephews of George Stephenson (Messrs. Hindmarsh and Langham, who had then the management of the Tapton Collieries) came to see the gauge at work, and as the pointer was moving round the dial, indicating the rise of steam in the boiler, these two young gentlemen put their ears to the gauge in order to ascertain if it was ticking, as in the movements of a clock."

Water Heaters Used 2,000 Years Ago.

The ancient Romans of 2,000 years ago fully understood and appreciated the principle of the water tube, the crowning feature of modern boilers, which was believed to surpass anything of the kind known to civilization. In two museums of Roman antiquities at Naples there are several water heaters, superior to many of modern make. One of them consists of an outer shell 12 inches in diameter and nearly 17 inches high, surmounted by a somewhat hemispherically shaped top. Inside this shell is an internal cylinder, also having a hemispherical top, which is ten inches in diameter and 12 inches high.

The two sheets were connected at the bottom by a rim, like the mud ring of a locomotive firebox, and the space between them was filled with water. The grate was formed of seven tubes made from sheet bronze, rolled or soldered or brazed. These tubes open at both ends into the bottom of the space between the sheets, thus forming a water tube grate for the fuel to rest upon. Charcoal was probably used with this heater and was placed on the grate through an opening 4.8 inches high and 4 inches wide, closed by a beautifully decorated door. The gases from the fire escaped into the outer air through three small openings formed by tubes crossing from the inner to the outer shell about 5.6 inches above the grate. The whole apparatus was raised about 12 inches on a tripod, so as to allow air to reach the fuel.—*Popular Mechanics.*

Penberthy Injector Co. Exonerated by Coroner's Jury

The coroner's jury, after holding an inquest lasting nine and one-half days rendered a decision on February 28th completely exonerating the Penberthy Injector Company, of Detroit, and their engineer, Samuel Riley, from responsibility for the death of thirty persons, caused by the disastrous boiler explosion at the works of the Penberthy Company on November 26th last. The verdict of the jury is as follows:

"That the said persons came to their death because of the explosion of the horizontal boiler in use in the works of the Penberthy Injector works, located on Brooklyn avenue and Abbott street, on the morning of Tuesday, November 26th, 1901.

"From careful attention to all the evidence as given and full consideration thereof in the jury room we find the Penberthy Injector Co., through the officers and the engineer in charge of said boiler, had given it proper care and attention, and are not responsible for the explosion.

"We further find from the scientific and expert testimony given that said boiler was not constructed of the material nor in the good workmanlike manner called for in the specifications furnished for its construction, and, therefore, that the makers of said boiler are responsible."

President S. Olin Johnson, who was naturally under a great strain during the inquest, was greatly relieved and warmly thanked the jurors.

The company is re-established and working full force again, but on account of the unprecedented demand for Penberthy Injectors they have had to put on both a day and night shift.

"Bread Cast Upon the Waters."

The Liberty Manufacturing Company, Pittsburg, has just received an order from Fraser & Chalmers, London, England, for Turbine Cleaners, to which was attached an advertisement inserted October, 1900, and the following day another order from a large firm in New York for Tribune Cleaners for boiler tubes and cleaners for economizer tubes, with hose, ordered from an advertisement which appeared more than 2 years ago.

These orders not only show that returns from advertisements are likely to continue for some years after the advertisement appears, but that the largest and best firms in New York and London as well as the humble engineer order from advertisements.

How and Where to Obtain Tools and Fittings.

There is probably no question more often in the mind of the engineer than that of the multiplicity of tools, special pipe fittings, check valves, compression tanks, etc., some one of which he is in daily need of. Thus the question is ever present, where shall I send for a certain tool or a special fitting? In answer to this question we would direct attention to one of the most modern steam supply houses in the country, that of C. J. Rainear & Co., 518 Arch Street, Philadelphia. Messrs Rainear & Co. not only carry a complete line of 20th century engine room equipment in the matter of tools, but also carry an extensive stock of valves for every conceivable requirement, in addition they are agents for the Williams Gauge

Company's feed Water regulator, gauge cocks, safety columns and steam traps; the Armstrong Stocks and Dies; a line of injectors, flue cleaners, steam joint cements, and in fact anything that an engineer requires in the matter of tools, etc. Besides this, they are in a position to make up, on the shortest possible notice, any special cuts of large size pipe or fittings. Mail orders will receive prompt attention and every effort will be made to satisfy the most exacting. If you are about to make a change in your plant or make any repairs which may require more than the usual amount of pipe, etc., a postal to the above address will bring an experienced representative who will be glad to furnish prices, suggestions, and in every way assist you in obtaining the necessary supplies at the lowest possible prices.

Cylinder Relief and Oil Extractor.

Messrs. E. F. Houghton & Co., of Philadelphia and Chicago, present herewith a sketch of what they claim to be a positive way of overcoming the bulk of the difficulty arising from both oil and water in steam cylinders. For simplicity and cheapness it certainly is surprising. It consists in attaching to the drips from each end of the cylinder a Marck Steam Trap which operates upon a thermostatic principle. These traps are therefore nothing more nor less than automatic valves. They remain always open excepting when live steam or air at

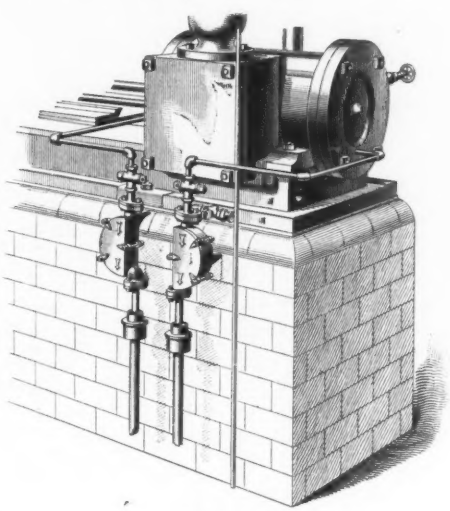


Figure 1

a temperature above 212° Fahrenheit attempts to pass through, when they immediately close.

Now E. F. Houghton & Co. claim that the pipes leading from the drips act as a reservoir into which gravity is bound to deposit the bulk of the water and free oil in the cylinder, and as a result, just as soon as these pipes are about half filled, the traps will open, drain them off, and close again without the loss of live steam.

The first cost of the trap, and cost of applying are scarcely more than that of an ordinary valve.

As shown in figure 1, it is well to have a discharge from these Marck traps so arranged that it can be inspected, and by this means the workings of the trap can be very easily noticed.

They claim to have these traps generally in use in Continental Europe, where they are looked upon as a part and parcel of the construction of any modern up-to-date engine, and the simplicity of the idea and its probable feasibility certainly commands the attention of every thinking engineer.

In addition to relieving the cylinder while under operation of all accumulations of oil and water, these traps remain open when the engine is not operating, drawing the cylinder and relieving it of probability of rust, and they remain open after the engine is put in operation until all water coming over into the cylinder has been drained out of the drips, thereby making them an automatic safety appliance, which if they had no other use would commend them to intelligent engineers.

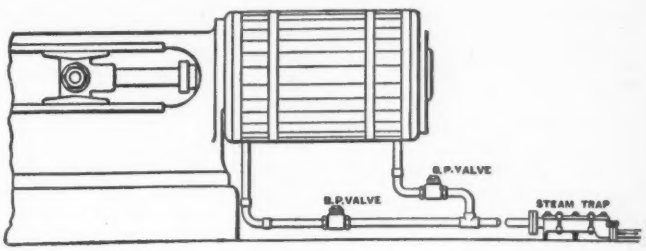


Figure 2

E. F. Houghton & Co. tell our representatives that they will send these traps to any responsible party, with the understanding that if after use for thirty (30) days they are not satisfactory they can be returned without any charge whatsoever for their use.

Figure No. 2, shows a similar cylinder taken care of by one trap by the installation of two back pressure valves. Now scale or something of that character is very apt to lodge in

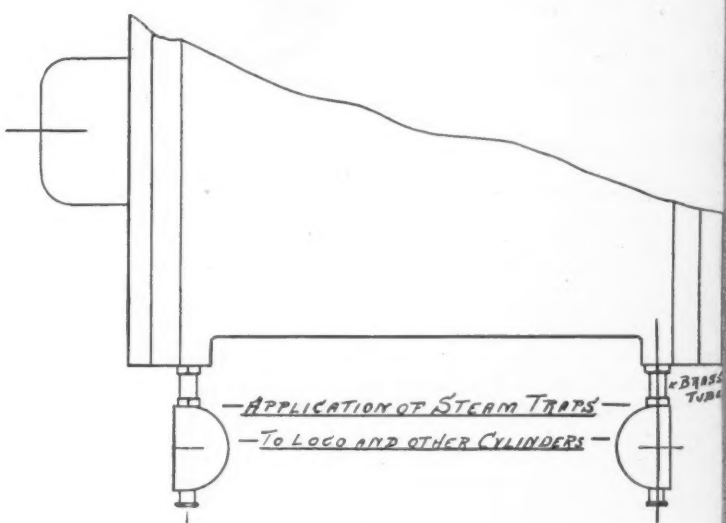


Figure 3

back pressure valves, and by such a method there is no means of knowing whether the drips from both ends of the cylinder are working satisfactorily, so that the plan as shown in Figure No. 1 seems preferable.

Figure No. 3 shows the traps applied to the drips of locomotive cylinders for which purpose they make a splendid steel trap, stronger and better able to stand the wear and tear caused by vibration.

TRADE NOTES.

Pittsburg has produced lots of good things, but it is doubtful if any of them have had a larger sale than the White Star Oil Filter, which is manufactured by the Pittsburg Gauge and Supply Co., 308 Water Street. The company has issued a book describing their filter in a most comprehensive manner. The illustrations alone make it worth having. Send for a copy and look it over for yourself.

Brandt's Triple Expansion Gaskets, manufactured by Randolph Brandt, 38 Cortland Street, New York, can be used over and over. Any of our readers who have trouble with their gaskets should loose no time in writing Mr. Brandt.

Do you want to buy an Indicator? Most engineers do, if they haven't one already. If you are thinking of getting one in the near future you should send for a copy of the catalogue published by Jas. L. Robertson & Sons, 205 Fulton Street, New York. It contains much valuable information about indicators and their uses.

A "Grate" Man who makes grate bars of all kinds, and good ones, too, is Chas. Robson, Eighth and Washington Avenue, Philadelphia. Mr. Robson publishes a neat little booklet which should be in the hands of every engineer who contemplates buying new grates. Mr. Robson will send one free.

Many engineers are not as familiar as they should be with the manifold uses to which a good expansion bolt can be put to advantage. D. C. Seaman & Co., 1638 Hutchinson Street, Philadelphia, are manufacturing a new and decidedly superior expansion bolt, which is ably described and illustrated in their new catalogue. Send for one.

A new edition of Webster's International Dictionary has been published by C. & C. Merriam Company, Springfield, Mass. The publishers have issued a small pamphlet describing the work and will be pleased to send a copy to anyone requesting same.

No Engine has ever given more universal satisfaction than the Corliss type, and it is extremely doubtful if any of that type have equalled the Richard Corliss Engine, built by the Corliss Engine Works, Howard and Huntingdon Streets, Philadelphia. This engine has stood the test of two score years, and has shown greater economy in operation with less cost of repairs than any engine that has come to our notice. If you are contemplating the purchase of a new engine it will pay you to write them to the address given above.

Mr. J. W. Parker, formerly well known to most of our local members through his former connections, has associated himself with T. T. Burchfield Co., 619 Arch Street, general representatives of the Improved Watertown High Speed Engine and the Hewes & Phillips Corliss Engines. Mr. Parker will be glad to renew his acquaintance with his old-time friends and make as many new ones as possible. Mr. Parker says the new Watertown Engine is as good as the best, and the Hewes & Phillips Corliss is too favorably known to warrant further comment. Mr. Parker hopes to hear from or see all of the engineering fraternity at his new office.

Good Service, no Charge. Geo. W. Lord, manufacturers of Lord's famous boiler compounds, 2238 North Ninth St., Philadelphia, will make a thorough analysis of a piece of the scale from the inside of your boiler, or a jug of your feed water, and submit a full report of same to you without any charge for same, if you will mention THE PRACTICAL ENGINEER.

American Engineers are rapidly adopting grease as a lubricant. This is doubtless due to its known lasting qualities as compared with oil, and to its freedom from splash and drips. The Keystone Lubricating Co., 20th and Allegheny Avenue, Philadelphia, one of the largest high grade grease manufacturers in the world, state that one pound of Keystone Grease will go as far as 3 to 4 gallons of oil. This seems like a remarkable statement, but they are willing to send any of our readers a sample can of grease and a brass cup free to prove it.

A handsome match box will be sent free to chief engineers and large steam users, who are interested in high grade metallic packings by A. W. France, Tacony, Philadelphia. Mr. France will also send a copy of his catalogue illustrating and describing his complete line of packings, upon request.

A new Steam Trap has just been placed upon the market, by the Direct Separator Co, 200 Marcellus St., Syracuse, N. Y. It is known as the Powers Steam Trap, and is a bucket trap, possessing many features that should commend it to steam users. Moreover the known reliability of the makers is worthy of the highest consideration. A new catalogue illustrating the trap and describing it in detail has been published by the company and they will send it to anyone interested.

The Cling-Surface Manufacturing Co. say they will be glad to furnish to any A. O. S. E. member a copy of their calendar until the few remaining copies are exhausted. They have received many letters in reply to these all of which prove that the men of the A. O. S. E. appreciate the advantages of a slack-running belt, free from slipping. J. K. Sedgwick, Cor. Engr., Mass., No. 14 adds, "Cling-Surface is about the best thing I have ever used."

The Burt Mfg. Co., of Akron, Ohio, has issued two very neat little booklets describing their Cross Oil Filter and the Burt Exhaust Head, copies of which will be sent to anyone upon application. It may be mentioned that the Cross Oil Filter was awarded the highest medal at the Pan-American Exposition and that its sale has extended to 28 different countries, while nine governments have adopted them for use in their navies, arsenals, etc.

A PUBLIC MAN

once remarked that political platforms were made to run on and not to stand on.

Same way with some advertisements. But when we say that a

CROSS OIL FILTER

will cut down your oil bills at least 50 per cent. we stand back of our promise—not one cent of money changes hands until a 30 days' trial of the Filter has convinced you that it is the best that money can buy.

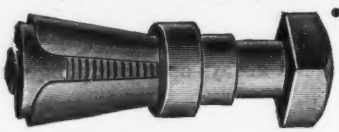
Adopted by nine governments and used in 28 different countries.

Can we send one?

THE BURT MFG. CO., Akron, Ohio, U. S. A.

Also to be had from oil companies, engine builders and power contractors.

THE POSITIVE EXPANSION BOLT



Special Discount to Jobbers. Write for Prices

Manufactured by D. C. SEAMAN & CO.

1638 Hutchinson St., Philadelphia, Pa.

For sale by Neal & Brinke, 18 Warren St., New York; Somers, Fiths & Todd Co., 323 Water St., Pittsburgh, Pa.

IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics. JOHN T. LINDSTROM, 440 Liberty Street, Allentown, Pa.

DO YOU KNOW

That we manufacture chemical water purifiers that are guaranteed to prevent and remove incrustation in steam boilers, no matter what its composition may be.

CHEMICAL PURIFIERS

that do this without injury to the boiler, its fittings or connections;

CHEMICAL PURIFIERS

that can be used with perfect safety in Breweries, Ice Plants, Dye Works and all places where the water of condensation is used for any purpose.

Write for terms, reports, circulars, etc. We interest you and pay liberal commission. Agents wanted everywhere.

THE PEERLESS SPECIALTY CO.

1720 N. 5th St. and 1711 N. Randolph St.

Philadelphia, Pa.

Mr. George A. Waddell, has been appointed chief electrician of the Merchants and Miners Transportation Co., Baltimore, Md.. Mr. Waddell is a graduate of the American School of Correspondence of Boston, Mass., and adds another to the list of those, who, coming from this institution, are able to make a good place for themselves.

Warren Webster & Co., Camden, N. J., have issued an unusually neat folder, illustrating the immense case factory of the Singer Mfg. Co., at South Bend, Ind., where Webster specialties are in extensive use. A copy will be sent upon request.

The Liberty Manufacturing Company, Pittsburg, report the following recent sales of the well known FAMOUS Oil Filter and Refiner: New York Athletic Club Building, New York city; Onondaga Lake Ry Company, Syracuse, N. Y.; L. M. Rumsey Mfg. Company, St. Louis, Mo.; Berliner & Son, New York city; Southern Elevator, East St. Louis, Ill.; The Grand Leader, St. Louis, Mo.; Iron River Water, Light & Power Company, Iron River, Wis.; The Arcade Building, East St. Louis, Ill.; Ashburn Mining Company, Folsom, Calif; City of North Vernon, Water and Light Dept., North Vernon, Ind.; Commercial Building, St. Louis, Mo.; Cannonsburg Elec. Light, Heat & Power Co., Cannonsburg, Pa.; Colorado Ice & Cold Storage Company, Kansas City, Kas.; Pitcher Lead Company, Joplin, Mo.; Peper Tobacco Company, St. Louis, Mo.; Firth Carpet Company, Firth Cliffe, N. Y.; John Schroeder Lumber Company, Milwaukee, Wis.; Armour & Co., Sioux City, Ia.; Messrs. Geo. I. Roberts & Bros., New York.

The Nonpareil Cork Covering Co. of Bridgeport, Conn., has purchased 5 acres of land in Camden, N. J., at the foot of Jefferson Street, where they propose to build a large and complete plant for the manufacture of Nonpareil Cork products. This plant will be in complete operation before their Bridgeport plant is abandoned. In fact the company may be forced to operate both plants for a year or two to supply the remarkable demand for this remarkable insulating material. The new plant will be operated by electricity, all machinery being motor driven.

Owing to the rapid increase in their business the Pilley Packing & Flue Brush Mfg. Co., find their present 5 story building inadequate, and as they cannot secure more room in their present location, they have closed contracts and are now having constructed for them a building designed especially for their work at Nos. 606, 608 and 610 South Third Street, occupying a lot of 60x161 feet. They expect to move into their new quarters the latter part of May next.

O. F. Zorn Co., 418 Vine St., Philadelphia, one of the oldest and most reliable lubricating oil houses in the country, inform us that their business has grown so rapidly of late that their immense compounding department has been worked to its full capacity. It is noticeable, too, that the increased demand is largely for higher grade oils than formerly, which condition they look upon as not only attesting the merit of their oils, but as substantial proof of the proclaimed prosperity of our manufacturing establishments.

YOUR BELTS

YOU DON'T WANT TO RUN TIGHT BELTS. DO YOU?

YOU HAVE TO. WE KNOW YOU DON'T BELIEVE IN BELT DRESSINGS.

WE DON'T BLAME YOU.

BUT YOU WILL BELIEVE IN CLING-SURFACE If you will investigate what it will do.

It penetrates a porous belt and leaves the surface clean—not sticky.

It preserves the belt, stops all slipping, so the belt can run easy under full load. This isn't what we say, it's what our customers say. We will show you if you wish. Get a package, test it, pay only if satisfactory.

CLING-SURFACE MFG. CO.,

185-191 VIRGINIA ST., - - - BUFFALO, N. Y.

NEW YORK—39-41 CORTLAND ST.

PHILADELPHIA—THE BOURSE.

WORKING OVERTIME

An hour a day will increase your wages a few dollars a week—**while the work lasts**. The same time spent studying at home has enabled our students in a few months to add **$25** to **$50** a month to their wages—**a permanent benefit.**

C. M. YATES, Oswosso, Mich., Says:
"Since I entered the School I have had my salary increased from $60 per month to $100, as chief electrician and engineer of the Owosso & Corona Electric Co., and I now do all my own rewinding and repairing of the electrical machinery, which before I had to send to some shop."

The School is chartered under the educational laws of Massachusetts, and students are taught by graduates of Boston's noted engineering schools. A few

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Mechanical Electrical ENGINEERING Steam Textile

Heating, Ventilation and Plumbing—including Mechanical Drawing

will be awarded to ambitious young men. Application should be made immediatly, as the number is limited. Tuition is absolutely free, the only expense being the actual cost of instruction papers and postage.

Further information and large illustrated Hand-Book describing courses, methods; regular terms will be sent on request to any reader of "The Practical Engineer."

American School of Correspondence

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SOMETHING

YOU SHOULD READ

GRAPHITE FOR VALVES AND CYLNDERS

is the title of a little pamphlet that tells of the experience of engineers who have used graphite for better lubrication.

SUPPOSE YOU SEND FOR ONE?

NO CHARGE

JOSEPH DIXON CRUCIBLE CO.

JERSEY CITY, N. J., U. S. A.

SALESROOMS AT

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London Office: 26 Victoria St., Wesminster

Keeping Oil Out of Boilers

Ten years ago it was hard, uphill work trying to sell Oil Separators. We knew we could take oil out of exhaust steam, and most successfully too, because our

Cochrane Oil Separators

were doing it. Steam users wanted the oil removed, but they didn't believe that we or anybody else were capable of performing the service to their satisfaction.

One by one we tackled and convinced the sceptics—we took them around to the different plants to see for themselves—we referred them to regularly inspected boilers that were being protected by "COCHRANES"—we went further—we told them how the trick was done—explained to their mechanical men all the details of design and construction. Slowly, but steadily, new names were added to the list. Every Separator installed made a record for itself. Each was an advertisement.

The introductory work is easier now. We can at this time refer to thousands of Separators where before to only fifty or a hundred. We can point to millions of horse power of boilers that are not troubled in the slightest degree with oil because of these "COCHRANES." The experience gained in solving exceptional and difficult cases enables us to insure success. We undertake to KEEP OIL OUT OF BOILERS. The service is not partially done—it is well done.

We are still glad to have the opportunity of making known the merits of our "COCHRANES" by explaining the principles involved, the construction followed, by citing references, showing installations, etc., and we expect to take the business on the basis of clean, clear-cut, honest claims, right prices and courteous dealings.

Would you like a folder, or catalogue "16-S" for example.

For Horizontal Pipes.

HARRISON SAFETY BOILER WORKS

3144 North 17th Street, PHILADELPHIA, PA.

American Order of Steam Engineers.

ORGANIZED APRIL 27, 1886.

An Order of Engineesr for Engineers and Engineers only.

DECLARATIONS OF PRINCIPLES

Believing that ability will bring its full value in this country, this Order shall at no time take part in strikes, nor in any way interfere between employer and employees. Recognizing their identity of interests, it shall take no part in any project or enterprise that shall interfere with perfect harmony between them ; neither shall it be used for political or religious purposes.

These principles shall not be amended or repealed except by unanimous vote of the Order.

Any member who shall be guilty of violating the principles of the Order shall be expelled.

OBJECTS.

First.—To promote a more thorough knowledge in its members of theoretical and practical steam engineering.

Second.—To assist members to obtain employment.

Third.—To help the sick, injured and distressed and bury the dead.

Fourth.—To establish a Widows' and Orphans' Fund.

Fifth.—To help members who shall become incapacitated from following the profession to obtain employment suited to their affliction.

Sixth.—To do our utmost to extend the license law throughout the United States.

Seventh.—To establish schools in which our members may study the highest branches of steam engineering.

MEMBERSHIP.

Candidates for membership must be citizens of the United States, of legal age, of good moral character, and sound of health and limb.

Applicants must have at least one year's active service as engineers, and where a license is required they must hold such license.

Applicants must satisfy the Investigation and Examining Committee of the Council to which they apply for admission, as to their character and ability.

No person shall be elected to membership who has been convicted of a felony in a competent Court of Justice, except he shall have been declared innocent after such conviction and shall have received a full and free pardon from the proper authorities.

LIFE MEMBERS.

Engineers who have past the age limit set by the subordinate Councils, may be elected to life membership. They must pass the same examination as to ability and character as an active member, and must present positive proof that they have been in charge of a steam engine at some time in life, for at least one year. They shall be entitled to all the rights of active members, except that they cannot hold office, vote at election or upon a financial question, or be entitled to any of the benefits.

DIRECTORY.

The Publication Committee of "The Practical Engineer" desires that the Corresponding Engineers of all Councils of the American Order of Steam Engineers send the name of their Chief Engineer and their own name and address, together with the time and place of meeting to the Secretary of the Publication Committee immediately after each election of officers. Address J. C. McDowell, Secretary, in care of "The Practical Engineer," 1215 Filbert Street, Philadelphia.

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Supreme Chief Engineer.—Clifford P. Williams, 528 Greenwich St. Phila.

Supreme First Assistant Engineer.—Noah A. Pierson, Fidelity Building, Baltimore, Md.

Supreme Recording Engineer.—Fred. W. Moore, 2628 Hancock St., Philadelphia.

Supreme Corresponding Engineer.—J. C. McDowell, 1913 South Eighth St., Philadelphia.

Supreme Treasurer Engineer.—Geo. W. Richardson, 144 Vassar St., Wissahickon, Phila.

Supreme Senior Master Mechanic.—W. S. Price, Haddon Hall, Atlantic City, N. J.

Supreme Junior Master Mechanic.—Joseph T. Harris, 1611 Clybourn St., Milwaukee, Wis.

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Supreme Outside Sentinel.—H. L. McGee, Baltimore, Md.

Supreme Chaplain.—John T. Dodge, 21 Spring Lane, Boston, Mass.

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PAST SUPREME CHIEF ENGINEERS.

Jerry Leahey, Jr., Harry G. Connor, B. F. Pettit, Geo. W. Richardson, H. B. Underwood, N. M. Kinney, James Lightfoot, J. T. Dodge, Jr., Franklin R. Moore.

DELAWARE.

Deputy Supreme Chief Engineer, David J. Stayton, No. 831 West 5th Street, Wilmington.

Wilmington.

Delaware, Council, No. 1, meets every Wednesday at S. E. Cor. Fourth and King Streets. Chief Engineer, W. D. Wyett. Corresponding Engineer, A. E. Deakyne, 406 Lombard Street.

INDIANA.

Deputy Supreme Chief Engineer, A. B. Maxwell, in care of Briggs Pump Works, Lafayette.

Lafayette.

Tippecanoe Council, No. 1. Corresponding Engineer, A. H. Mathieson, Water Works, West Lafayette.

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New Iberia.

Evangeline Council. Chief Engineer, John B. Lanaier. Corresponding Engineer, W. J. Maynard.

MARYLAND.

Baltimore.

Deputy Supreme Chief Engineer, James H. Stallings, 3032 Dillon Street, Baltimore, Md.

Maryland Council, No. 1, meets 2d and 4th Fridays in Royal Arcanium Hall. Chief Engineer, J. C. W. Schrier. Corresponding Engineer, Wm. S. Smith, 116 W. Lee Street.

Energy Council, No. 2, meets every Wednesday of each month in Bauer Hall, Cheaspeak and Elliott Sts. Chief Engineer, Philip A. Kirkwood. Corresponding Engineer, Jos. H. Stallings 3032 Dillon St.

MASSACHUSETTS.

Deputy Supreme Chief for Eastern District, W. E. Packard, Whitmann.

Boston.

Bay State Council, No. 1, meets second and fourth Fridays, at 149 Staniford Street. Chief Engineer, J. F. Cochrane; Corresponding Engineer, W. S. Trofatter, 777 Parker St., Roxbury.

Boston Council, No. 4, meets 2d and 4th Thursday of each month in Templar Hall, 724 Washington Street. Chief Engineer, Harry G. Black. Corresponding Engineer, Wm. T. A. Faulkner, 41 Worcester St.

Brockton.

Shoe City Council, No. 2, meets 1st and 3rd Wednesday evenings in Red Men's Hall. Chief Engineer, Rufus J. Condon; Corresponding Engineer, G. W. Prentice, 19 Brunswick St.

Worcester.

Central Council, No. 3, meets second and fourth Tuesdays, at 566 Main Street (Central). Chief Engineer, Wm. P. Barnes. Corresponding Engineer, J. C. Ryan, No. 5 Hanover Street.

Malden.

Malden Council, No. 7, meets every Thursday evening in Templar Hall, Pleasant St. Chief Engineer, Frank M. Perkins. Corresponding Engineer, Geo. P. Milliken, cor. Mulford and Green Streets.

Orange.

Orange Council, No. 9, Meets 2d and 4th Fridays. Chief Engineer, Chas. Gartrell; Corresponding Engineer, Fred. L. Hale.

Holyoke.

Mount Tom Council, No. 10, meets every Thursday, in Y. M. C. A. Building. Chief Engineer, William Flory. Corresponding Engineer, Theo. W. Crosby. No. 43 Canal street.

North Adams.

Stewart Council, No. 11, meets second and fourth Wednesdays, at Old Liberty Building. Chief Engineer, C. W. Lewis. Corresponding Engineer, T. G. Fillebrowne, 134 River Street.

Rockland.

Old Colony Council, No. 14, meets second and fourth Saturdays in the American Foresters' Hall. Chief Engineer, E. H. Naylor. Corresponding Engineer, James K. Sedgwick P. O. Box, 333, Rockland, Mass.

NEW JERSEY.

Deputy Supreme Chief, F. O. Garrison, Bridgeton, N. J.

Perth Amboy.

Stevens Council, No. 1, meets third Saturday, at Water, near Lafayette Street. Chief Engineer, Lawrence Oliver. Corresponding Engineer, James H. White.

Camden.

Camden Council, No. 3, meets every Thursday evening at N. E. corner 2d and Federal Street. Chief Engineer, S. R. Middleton. Corresponding Engineer, C. H. Pfeiffer, 671 Berkley St.

Atlantic City.

Atlantic City No. 4 meets every Tuesday evening at Merchants, Cor. Atlantic and New York Avenues. Chief Engineer, R. Endicott. Corresponding Engineer, W. S. Price, Haddon Hall.

Bridgeton.

Bridgeton Council, No. 5, meets every Friday. Chief Engineer, David Sellers. Corresponding Engineer, Francis O. Garrison, Bridgeton, N. J.

Millville.

Millville Council, No. 6, meets every Saturday, 7.30 p. m., in G. A. R. Hall, East Main St. Chief Engineer, Geo. Esabel. Corresponding Engineer, Lewis Doughty, 604 Mulberry Street.

NEW YORK.

Syracuse.

John E. Sweet Council, No. 6, meets Monday, Room 23, Nottingham Block, East Washington Street. Chief Engineer, John Cunningham. Corresponding Engineer, S. A. Steel, 311 Orange street.

PENNSYLVANIA.

Grand Chief Engineer, Hiram Trout, 1105 North Tenth street, Reading, Pa. Grand Corresponding Engineer, Frederick Markoe, 931 Orianna street, Philadelphia.

Philadelphia.

Welcome Council, No. 2, meets every Friday, in Necterline's Hall, 12th Street above Columbia Avenue. Chief Engineer, Paul Pieling. Corresponding Engineer, L. D. Woodington, 2428 N. Bancroft st.

Kensington Council, No. 3, meets every Thursday, at A. P. A. Hall, Frankford Avenue and Master Street. Chief Engineer Wm. C. stolt. Corresponding Engineer, Charles Fournier, 3115 Richmond St., Philadelphia.

Southwark Council, No. 4, meets every Monday, at corner of Reed and Eighth Streets. Chief Engineer, Walter Sommers. Corresponding Engineer, J. C. McDowell, 1913 S. 8th Street.

(Continued on page 26.)

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Manayunk Council, No. 9, meets second and fourth Friday evenings in Temperance Hall. Chief Engineer, Richard Wallace. Corresponding Engineer, John Clevenger, 211 Lofty Street.

Lafayette Council No. 11, meets second and fourth Tuesdays, in Grantz Hall, Main and Manheim Sts., Germantown. Chief Engineer, W. H. Tropley. Corresponding Engineer, James H. Gomersall, 22 Ashmead Street, Germantown, Philadelphia.

Helping Hand Council, No. 12, meets every Tuesday evening at Jasper and Huntington Streets. Chief Engineer, Thos. Evans. Corresponding Engineer, Frank McHugh, 2503 Tulip St.

Municipal P. F. D. Council, No. 20, composed exclusively of engineers of Philadelphia Paid Fire Department, meets quarterly at Girard Hall, Girard Ave. above Sixth. Chief Engineer, Frederick Markoe. Corresponding Engineer, Walter Meyers, 1211 North Howard Street.

Girardville.

Girard Council, No. 8, meets every Tuesday evening at O'Neill's Hall, 2nd and Ogden Sts. Chief Engineer, Jacob Weber. Corresponding Engineer, M. J. Carey, Lock Box 214.

Norristown.

Montgomery Council No. 5, meets first and third Wednesdays of each month at New Red Men's Hall, Main St. above DeKalb. Chief Engineer, L. Purdy. Corresponding Engineer Wm. H. Shainline, Jr., 528 Green Street.

Allentown.

Lehigh Council, No. 15, meets every Wednesday evening at 639 Hamilton St. Chief Engineer, Jacob Donnecker. Corresponding Engineer, A. P. Driesbach, 549 W. 10th St.

Pottstown.

Pottstown Council. No. 14, meets first and third Saturday evening at P. O. S. of A. Hall. corner High and Hanover Sts. Chief Engineer, Joseph Rhoads, Corres., Engineer, H. L. Shirey, 392 Cherry St.

Reading.

Progress Council, No. 13, meets every Saturday evening at Diebert Hall, 9th and Penn Sts., Room 4. Chief Engineer, Frank S. Miller. Corresponding Engineer, James M. Fisher, 1224 Oley St.

Chester.

Delaware County Council, No. 6, meets every Wednesday evening in the Carpenter Hall, 6th and Wall St. Chief Engineer, John Canavan. Corresponding Engineer, E. E. McCoy, 2222 West 3d Street.

York.

York Council, No. 16, meets every Wednesday evening in the Jordan Block. Chief Engineer, F. Seyler. Corresponding Engineer, Walter H. Long, 23 East Philadelphia Street.

Harrisburg.

Capitol City Council, No. 17, meets every Tuesday evening in Red Men's Hall, Market Street, above Second. Chief Engineer, B. H. Shafer. Corresponding Engineer, S. Filson, 1126 Market Street.

Columbia.

Columbia Council, No. 18, meets every first and third Saturdays, in Bittner's Hall. Chief Engineer, R. K. Grosh. Corresponding Engineer, W. J. Courtney, 804 Walnut Street.

Sunbury.

Sunbury Council, No. 19, meets every second and fourth Thursday in Zartman's Hall. Chief Engineer, Aaron Buck. Corresponding Engineer, Ed. Schrieber.

WISCONSIN.

Deputy Supreme Chief Engineer, Joseph P. Harris, No. 1611 Clybourn Street, Milwaukee.

Milwaukee.

Washington Council, No. 1, meets every Saturday at 207 Grand Avenue. Chief Engineer, J. B. Chambers. Corresponding Engineer, James A. Rigby, 136 Reed Street.

Clifford P. Williams Council, No. 2, meets every Thursday evening 298 4th Street. Chief Engineer, David T. Richardson. Corresponding Engineer, Jas. T. Harris, 1611 Clybourn Street.

TENNESSEE.

Deputy Supreme Chief Engineer, John B. Mullen, 826 Central Ave., Nashville.

Nashville.

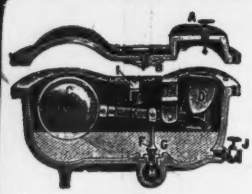
Enterprise Council, No. 1, meets every Friday evening in the Twin Building on Cedar St. Chief Engineer, J. J. Johnson. Corresponding Engineer, Jno. B. Mullen, 209 Jackson Building.

OREGON.

Deputy Supreme Chief Engineer, Benjamin F. Myrick, P. O. Box No. 1. Grant's Pass, Oregon.

Grant's Pass.

Oregon Council No. 1. Chief Engineer, William H. Kenny. Corresponding Engineer, Benj. F. Myrick, P. O. Box No. 1. Meets every first and third Saturday. A. O. U. W Hall, Main St.



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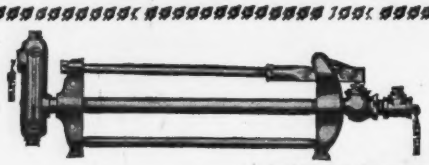

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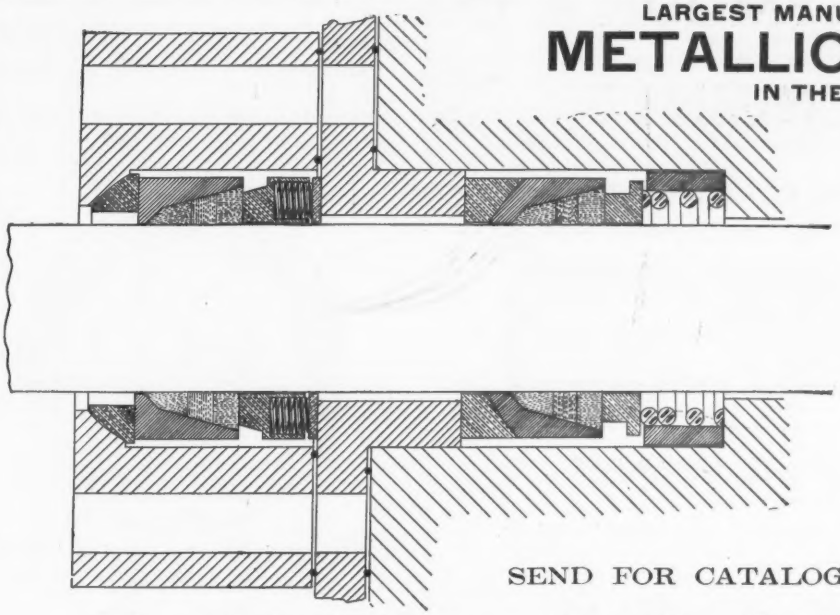

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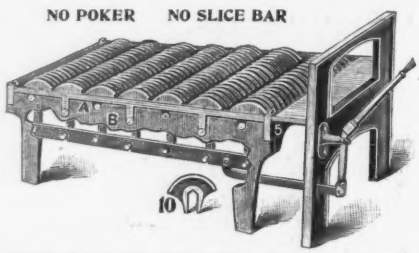

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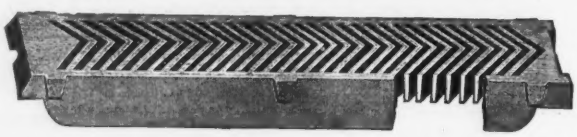

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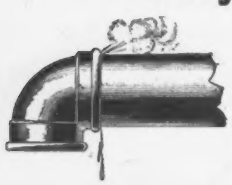

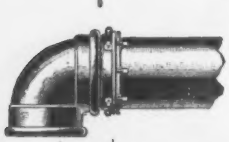

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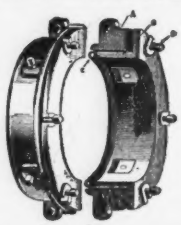

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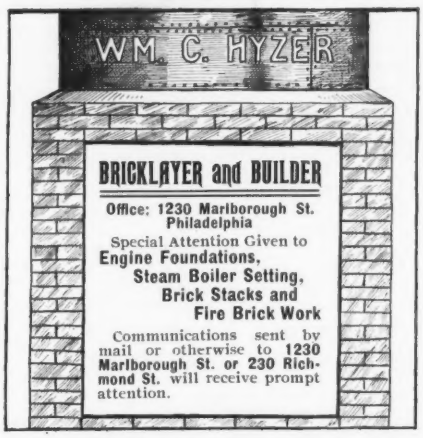
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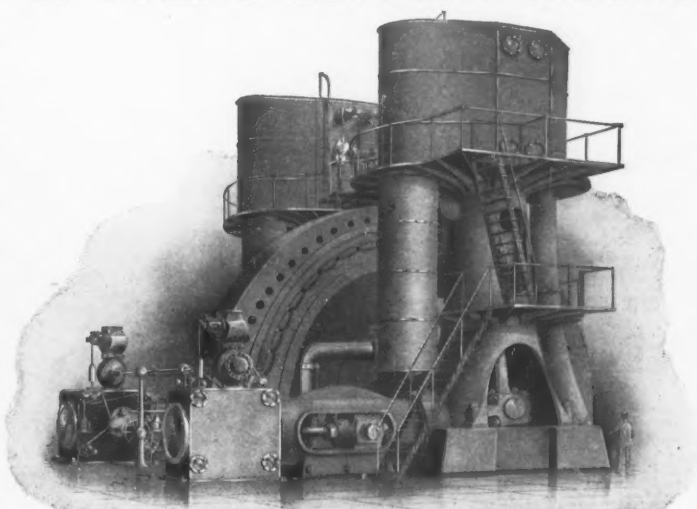

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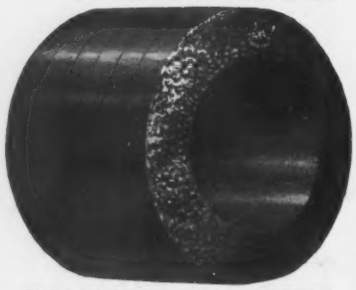

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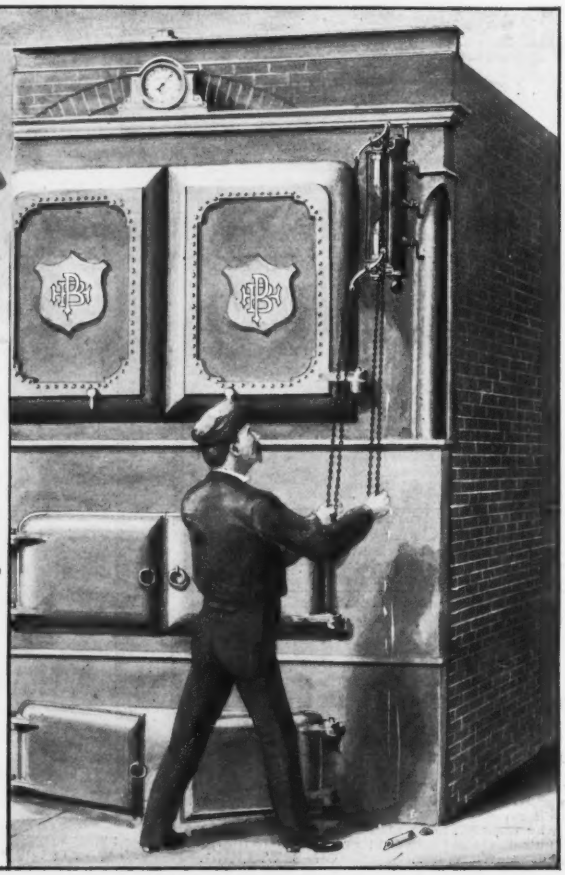

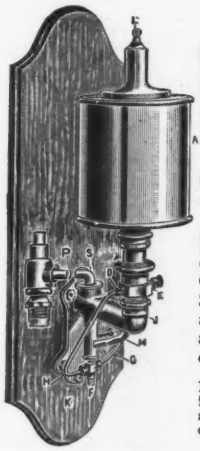

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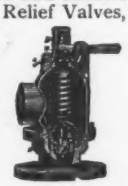

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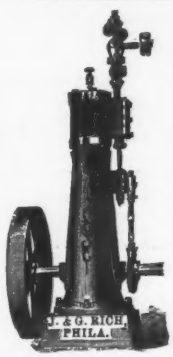

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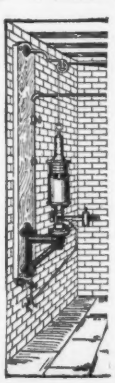

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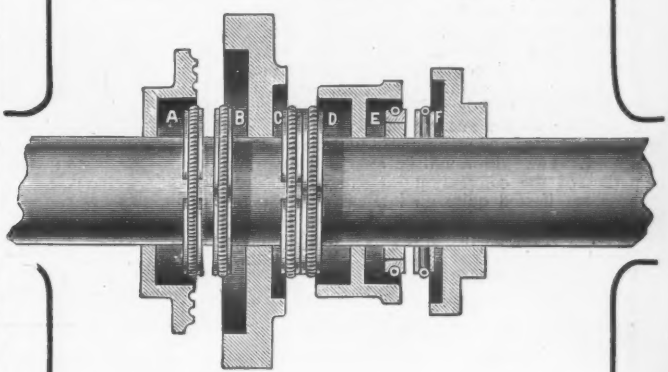

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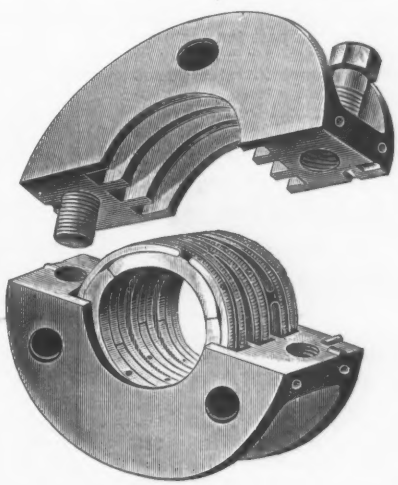

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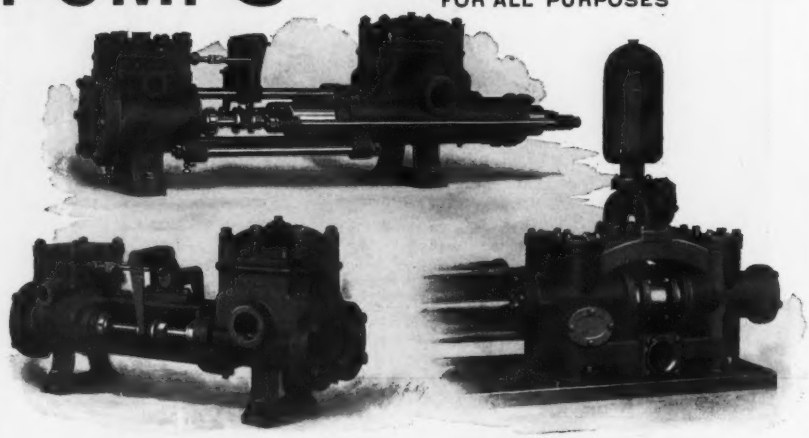

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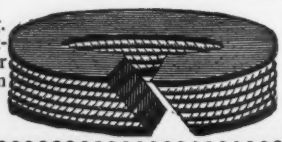

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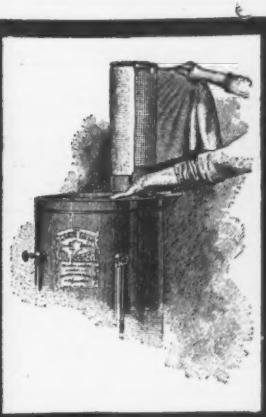

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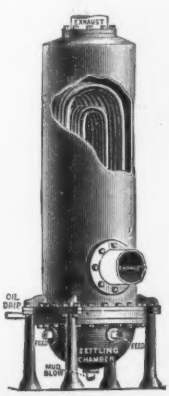

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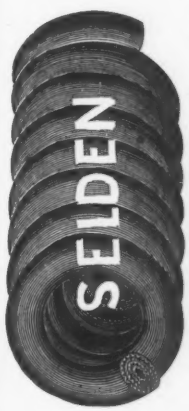

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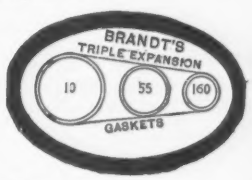

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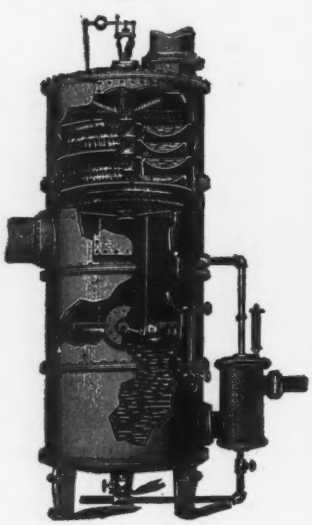

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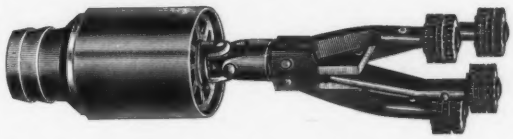

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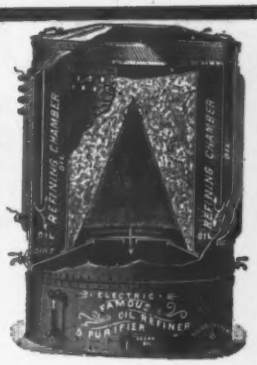

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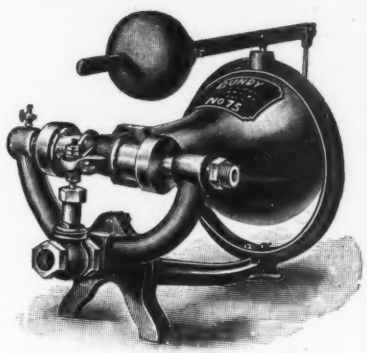

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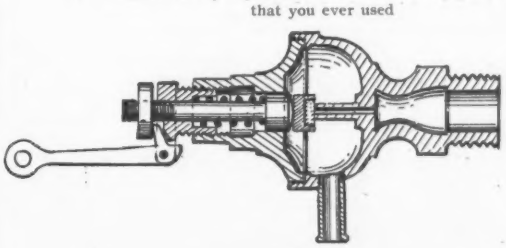

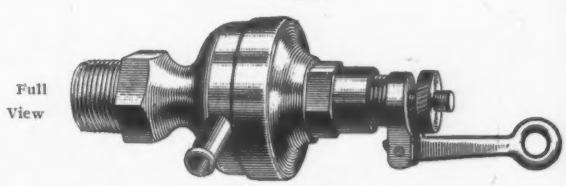

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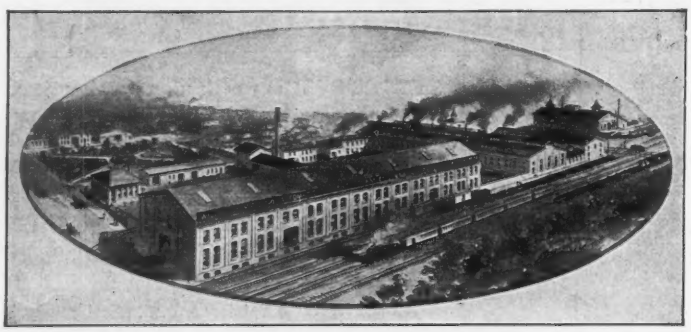

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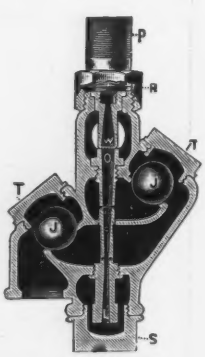

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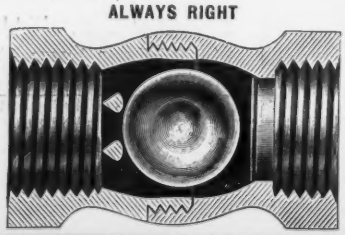

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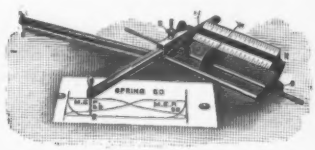

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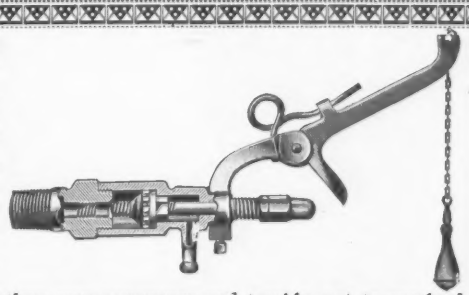

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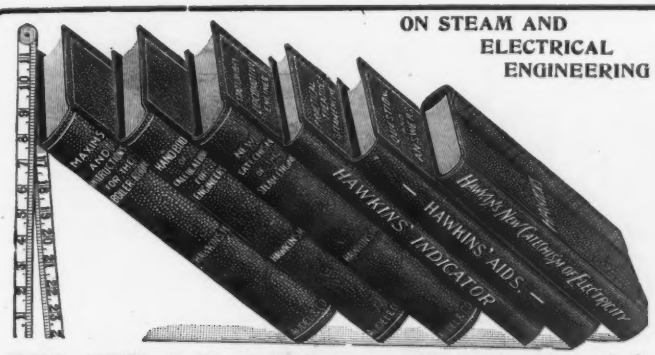

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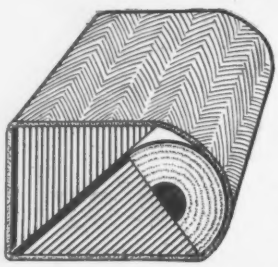

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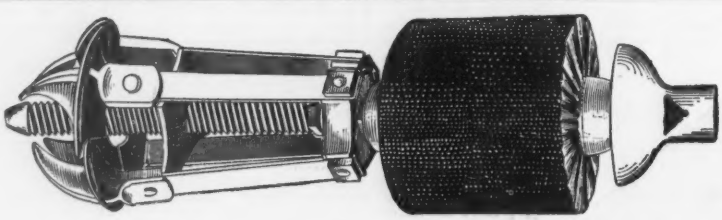

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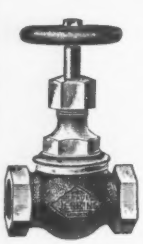

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